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Equity REIT Return Variability

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Abstract

Applying a conditional expectation model on a large sample of equity REITs for the period 1977 through 2017, we document strong evidence of time-varying betas on systematic risk loadings. This finding is robust across REIT portfolios and suggests that corporate characteristics such as size and the book/market ratio are important determinants of REIT returns. We confirm that REIT returns are predictable before 1992 but not thereafter. In particular, we find that conditional risk loadings explain this predictability. Our findings suggest that the previously documented predictability of REITs using latent variables is not necessarily inconsistent with market efficiency.

***JEL* Classification:** G12, R33

Keywords: REITs, pricing, predictability

1. Introduction

Real estate investment trusts represent a growing market sector that is gaining a growing role in investment practice. The economic determinants of REIT pricing are, therefore, an important research subject. In this study, we examine the predictability of equity REIT returns and the cross-section of equity REIT returns using conditioning variables. Following Fama and French (1993, 1995, and 1996), who demonstrate the explanatory power of both firm size and the book-to-market ratio in equity pricing, we construct portfolios of a large sample of equity REITs, three size-based equity REIT portfolios, three book-to-market based equity REIT portfolios, and nine size and book-to-market based equity REIT portfolios for the period 1977 through 2017.

We provide evidence that conventional conditioning variables predict equity REIT returns prior to 1992 but not thereafter. Lagged conditioning variables, such as the dividend yield on S&P 500 companies, the credit spread on Baa and Aaa bond yields, and the term spread on one-year and ten-year treasury bond yields, exhibit significant explanatory power on equity REIT returns before 1992. We investigate the time varying risk loadings of REITs under the Ferson and Harvey (1999) time-series stochastic pricing model and provide strong evidence of time-varying risk loadings for equity REITs. This finding suggests that the co-movement between REIT returns and market factors is time-varying and contingent on investors' perception of the strength of the market based on lagged macroeconomic variables.

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In contrast, consistent with market efficiency, there is no evidence of time-varying alphas for equity REITs. We also show, consistent with Pesaran and Timmermann (1995), that the high market volatility in the pre-1992 period is related to the predictability of REITs. For the full sample, the excess return of the market index, the three Fama-French factors and a momentum factor are significant risk factors in explaining the cross-sectional variation of REIT returns.

It is noteworthy that prior research generally makes use of market aggregated data where characteristics of individual REIT returns and REIT portfolios grouped by specific characteristics are not included. This article focuses on the impact of conditioning variables on cross-sectional variation of REITs, and provides a more complete updated description of the pricing of REITs.

Advances in asset pricing theory have been introduced in the field of real estate. Following the Fama and French tradition, Ling and Naranjo (1997) find that several significant macroeconomic variables systematically impact real estate returns. Glascock, Lu, and So (2000) document a cointegration between REITs and the stock market using monthly data. They conclude that REITs behave like bonds before 1992, but behave like small capitalization stocks after 1992. We use 1992 as the break point for our sample in further analysis. Structural change occurs at this time with tax reform in 1993 and the substantial development of the REIT industry in the 1990s (Glascock, Lu and So, 2000). This breakpoint is also consistent with the global recession beginning in 1990 (e.g., Quan and Titman, 1999).

Asset pricing theory is also directly utilized in the related REIT return predictability literature. Liu and Mei (1992), Mei and Liu (1994), Mei and Gao (1995), Karolyi and Sanders (1998), Ling, Naranjo and Ryngaert (2000), and Cooper, Downs and Patterson (2000) provide evidence that REIT returns are predictable. For example, with a sample of REITs spanning 1971-1989, Liu and Mei (1992) and Mei and Liu (1994) find that lagged macroeconomic variables such as the dividend yield and capitalization rate predict stock market and REIT returns. More recently, with a sample of 301 REITs for the period 1973-1995, Cooper, Downs, and Patterson (2000) document strong evidence of nonlinearities in the predictability of real estate returns, when including volume in the trading rule. Examining a sample of REITs from 1980 to 1996, Ling, Naranjo, and Ryngaert (2000) find that equity REIT returns are far less predictable out-of-sample than in-sample. This inability to forecast out-of-sample performance is particularly true in the 1990s. A potential explanation is that the predictability of REITs for the period before 1990 has become well-known, and investors have been using these strategies and arbitraging away the potential profits associated with them. It may also indicate that some of the results from the 1980s are period-specific.

In a related paper, Pesaran and Timmermann (1995) find that the predictability of stock returns changes over time: Returns are less predictable during the less volatile market of the 1960s, but more predictable in the volatile market of the 1970s. Predictive variables do not have the same power over time: The only variable that is predictive throughout the sample is the T-bill rate. The dividend yield is a predictive variable of stock returns only in the later sub-sample period of 1970-1992. Pesaran and Timmermann conclude that the predictable component of stock returns is related to the business cycle.

Our conditional expectation model and findings can explain the previously documented REIT return predictability. Consistent with Ling, Naranjo and Ryngaert (2000), we show that the REIT market becomes less volatile and less predictable beginning in the early 1990s. Thus, REIT predictability is not constant over time. Consistent with Pesaran and Timmermann's (1995) finding on stocks, we also find that the predictable component of stock returns is related to the business cycle. In particular, the time-varying risk loadings under our conditional expectation model explain the predictability of REIT returns using latent variables. Therefore, the previously documented predictability of REIT returns is not necessarily inconsistent with market efficiency.

The remainder of this paper is organized as follows. Section 2 describes the methodology employed in the study. Section 3 describes the data. Section 4 presents the empirical results. Finally, Section 5 summarizes the paper.

2. Methodology

Following Ferson and Harvey (1999), we investigate the impact of conditional expected returns on the aggregate REIT market and REIT portfolios grouped by specific characteristics. Ferson and Harvey show that loadings on the predetermined economic variables provide significant cross-sectional explanatory power for stock returns. They also find that the size and book/market factors leave out important cross-sectional information about expected returns, even in portfolios formed to maximize the potential explanatory power of these variables. In this study, we focus on the common dynamic patterns, captured by a standard set of economic instruments. The contemporaneous and inter-temporal impact of these instruments is extensively examined.

The Fama French framework is a specification of the general APT model. It identifies the relevant risk in a linear return-generating process:

$$R_{i,t+1} = E_t(R_{i,t+1}) + \beta'_{it}\{R_{p,t+1} - E_t(R_{p,t+1})\} + \varepsilon_{i,t+1}, \qquad (1)$$

where $E_t(\varepsilon_{i,t+1})=0$, $E_t(\varepsilon_{i,t+1}R_{p,t+1})=0$. $R_{i,t+1}$ is the excess return for any stock or portfolio *i* over the return to a one-month Treasury bill, and $R_{p,t+1}$ is a vector of returns of portfolios assembled based on a set of specific risk factors. Under the Fama French framework, R_p is a vector of three factors: the excess return of the market index, HML and SMB, where HML is the return on the portfolio long in high book/market stocks and short in low book/market stocks and SMB is the return on the portfolio long in small capitalization stocks and short in large capitalization stocks. This factor model expresses the unexpected excess return, $R_{i,t+1} - E_t(R_{i,t+1})$, as a linear regression on the unexpected parts of the factors.

Equation (1) does not specify the determination of the risk loadings. A simple application of this model restricts the betas to be constant over time and thus, assumes no variation over time in market risk premiums. Consistent with Ferson and Harvey (1991) and Ferson and Schadt (1996), the methodology employed by Ferson and Harvey (1999) allows for time-variation in the conditional betas. The econometric model takes the following form,

$$R_{i,t+1} = (a_{0i} + a'_{1i} Z_t) + (b_{0i} + b'_{1i} Z_t) R_{p,t+1} + \varepsilon_{i,t+1} \qquad (2)$$

where $\alpha_{it} = (a_{0i} + a'_{1i} Z_t)$ and $\beta'_{it} = (b_{0i} + b'_{1i} Z_t)$ are the time-varying alpha and beta conditioned on Z_t, a vector of mean zero information variables known at time *t*. Parameters of the model are denoted a_{0i}, a_{1i}, b_{0i} and b_{1i}. The model does not impose a functional form for the expected premiums, and allows us to address the time variation in the conditional betas.

When testing the time varying alpha, allowing a time varying beta, we first run equation (2) and obtain the *R*-squared value (R-squared (2)). We then restrict a_{1i} to be zero, and run the following regression and obtain the *R*-squared value (R-squared (3)):

$$R_{i,t+1} = a_{0i} + (b_{0i} + b'_{1i} Z_t) R_{p,t+1} + \varepsilon_{i,t+1}. \qquad (3)$$

The *F*-statistic:

$$F = R\text{-squared } (2) - R\text{-squared } (3) \qquad (4)$$

follows an $F(N, M-P-1)$ distribution, where N is the order of a'_{1i}, M is the number of observations in the regression, and P is the number of parameters in equation (2). If the F-statistic is significant and positive, this implies that including the time-varying alphas in the equation provides additional explanatory power.

When testing the time varying alpha, not allowing a time varying beta, we restrict b'_{1i} to be zero in both equations (2) and (3). When testing the time variation of betas, we follow a similar method, but control for b'_{1i} instead of a'_{1i}.

3. Data

We obtain monthly returns on all U.S. equity REITs for the period August 1977 through December 2017. We first select all REITs from the COMPUSTAT database with industry code 6798 (REIT). We then check the constituents of the NAREIT equity index to identify the current equity REITs. For the REITs not included in the current NAREIT equity index, we search *Lexis-Nexis* to identify their business scope.

We include all identified equity REITs in the merged COMPUSTAT and CRSP databases and construct value-weighted and equal-weighted All-REIT portfolios. Individual equity REITs are placed in three groups according to their prior-period equity market capitalization, and then on the basis of the ratio of book value to market value per share. This 3x3 stratification results in 9 equity REIT portfolios. Market capitalization and the book-to-market ratio are common criteria for sorting stocks in empirical investment studies. Such sorts often produce dispersion in a number of other characteristics for cross-sectional analysis. In order to examine the size and value effects separately, we also construct three size-based equity REIT portfolios and three book-to-market based equity REIT portfolios. These portfolios are annually rebalanced, consistent with Fama and French (1993), based on the market capitalization and the book-to-market ratio at the end of each July, which coincides with the end of the COMPUSTAT second quarter. The market factors (Market, SMB, HML, and UMD) are obtained from the website of Kenneth French.

All equity REITs in the 1977-2017 period are included in our study to avoid the problem of survivorship bias. The use of equity REIT portfolios, instead of individual REITs, minimizes the problem of nonsynchronous trading since any autocorrelation associated with individual REIT returns is minimized. Table I reports summary statistics. The value-weighted All-REIT portfolio generates 1.299% monthly returns in the sample period compared to 1.051% monthly returns for all stocks (including REITs), while their standard deviations are similar. Generating 1.320% monthly returns with a standard deviation of 3.936%, the equal-weighted All-REIT portfolio outperforms the stock market in the sample period. The REIT portfolios exhibit higher first order autocorrelations (0.119 for value-weighted; 0.272 for equal-weighted) than the stock market (0.028).

While smaller stocks are generally regarded as having higher growth potential and risk, hence higher returns, the literature has not conclusively demonstrated a similar small size effect for REITs. For example, Yang (2001) provides evidence of scale economies in REIT management. This suggests that larger-sized REITs may have better performance than smaller REITs. On the other hand, Gentry, Kemsley, and Mayer (2003) document that smaller REITs suffer market value discounts relative to larger REITs, ceteris paribus. If the reduced management economies of scale for small REITs is fully discounted in their market prices, small capitalization REITs may still have returns comparable to large REITs.

Table I reports that the small REIT portfolio (S1) has a monthly return rate of 1.318% in the sample period, greater than the 1.190% monthly return rate of the large REIT portfolio (S3). However, the performance of the REIT portfolios does not decline monotonically with size. To further examine the performance of REITs in the post-1992 market, we calculate the returns of the three size based portfolios for the period August 1992 – December 2017. Returns of small (S1), medium (S2) and large (S3) REIT portfolios in this period are 1.242%, 1.174% and 1.039%, respectively (not reported). These return rates decrease monotonically with REIT capitalization, consistent with the broader stock market.

In the broad market, stocks with higher book-to-market ratios tend to outperform those with lower book-to-market ratios. This is also observed in the REIT market (Table I). The low book-to-market ratio REIT portfolio (B1) generates 1.161% monthly returns, below the 1.426% monthly returns of the high book-to-market ratio REIT portfolio (B3). This result is consistent with economic intuition. Investors pay a premium to purchase low book-to-market ratio REITs, and their future returns are thus lower than for REITs with high book-to-market ratios.

The lagged instrumental variables that we use, Z_t, are consistent with those used by Ferson and Harvey (1999) and previous studies. These variables are: (1) the difference between the one-month lagged returns of a three-month and a one-month Treasury bill (“hb3”); (2) the dividend yield of the Standard and Poor’s 500 index (“div”); (3) the spread between the Moody’s Baa and Aaa corporate bond yields (“junk”); (4) the spread between a ten-year and a one-year Treasury bond yield (“term”); and (5) the lagged value of a one-month Treasury bill yield (“T-bill”). These variables are consistent with Liu and Mei (1992), who along with Campbell (1987), Fama and French (1988), and Ferson (1989), include the T-bill, the spread between the yields on long-term AAA corporate bonds and the one-month Treasury bill, and the dividend yield on the equal-weighted market portfolio. Our “junk” spread and “term” spread further decompose Liu and Mei’s spread into credit and term-structure variables.

4. Empirical Results

4.1. The Fama-French Model and the Real Estate Factor

Fama and French (1993) find that the difference in returns of portfolios of small capitalization stocks and large capitalization stocks (SMB) and the difference in returns of portfolios of high book-to-market stocks and low book-to-market stocks (HML) help to explain the returns of common stocks, along with the general stock market factor. Carhart (1997) augments this three-factor model with the "momentum" factor first described by Jegadeesh and Titman (1993). The momentum factor (UMD) reflects the phenomenon that portfolios of stocks with relatively high returns tend to have high returns in the subsequent year. In this section, we use this four-factor model to explain REIT returns.

Table II reports the regressions of REIT returns under the augmented Fama-French framework. All four factors exhibit significant (1%) explanatory power on the REIT returns for the sample period 1977-2017. The R-squareds are high, indicating reasonable goodness-of-fit. REIT returns for the equal-weighted portfolio, in comparison to the value-weighted portfolio, are more strongly related to the four factors, possibly because large REITs dominate the value-weighted portfolio and their idiosyncratic volatility is weighted more heavily. Given the limited number of REITs in the market, the equal-weighted All-REIT portfolio is more diversified, and its comovement with the general stock market is more representative in an asset pricing context. The constant term in each regression is not significantly different from zero. We then divide the sample into two periods, before and after 1992, in order to examine differences in the relation between REIT returns and the four risk factors across the two periods. The momentum factor (UMD) does not exhibit a significant relation to the REIT returns in the period August 1977-July 1992, though significantly related to the REIT returns for the period August 1992-December 2017.

4.2. Time-varying Betas

In this section, we present evidence that the lagged instruments track variation in the expected REIT returns that the three Fama-French factors do not capture. The lagged instruments appear to have explanatory power since they allow for time-variation in betas of the other three factors. Therefore, the conditional model adds value over and above the three-factor model from the previous section.

To allow for time-variation in betas, we perform regressions in which the lagged instruments enter the models through the conditional betas. Table III reports the results of estimating the time-series regression (1) for each of the constructed portfolios under the Fama-French framework. We first examine the portfolios of all REITs. Keeping the alphas constant, we show that the R-squareds are 0.324 and 0.374 for a constant beta and a time-varying beta, respectively, in the regressions of the value-weighted All-REIT portfolio. The F-test on the hypothesis of no time-varying beta has a p-value of approximately 0.001. The results are similar when we allow time-varying alphas in the regressions. Consistent with Ferson and Harvey's (1999) finding for stocks, these results suggest that the REIT sector has time-varying exposure to risk factors. More than half of the three size-based portfolios and three book/market-based portfolios exhibit time-varying betas. Of the nine stratified size and book-to-market portfolios, eight exhibit significant evidence of time-varying betas when constant alphas are imposed, and seven exhibit significant evidence of time-varying betas when time-varying alphas are allowed. These results strongly support the hypothesis that REITs exhibit time-varying risk loadings, and that this time varying risk loading helps to explain the cross-sectional variation of REIT returns.

4.3. Are the Alphas Time-varying?

Table IV reports the results of the tests on alphas. The first column presents the annualized intercept in percent. The alphas are mostly positive but with no significant deviation from zero. The second column reports the right-tail p-values of a heteroskedasticity-consistent test of whether this intercept is equal to zero. Only 4 of the 17 REIT portfolios exhibit p-values below the conventional significance level of 5%. The third and fourth columns report the p-value of F-tests on time-varying alphas in the settings of constant and time-varying betas, respectively. These statistics consistently show no evidence of time variation in the alphas. This is in contrast to Ferson and Harvey's (1999) finding on stocks, but consistent with market efficiency.

4.4. Variation of Risk Premiums

In the fairly short history since its inception, the REIT market has experienced substantial changes and growth. During this time period, both the stock and REIT markets have experienced a number of economic cycles. It is thus plausible to look into the time variation of risk premiums of REITs. Using equation (2), we decompose the total return of the value-weighted All-REIT portfolio into the expected premium and the residual return.

In Table V we report the mean and volatility of total REIT excess returns for the two sub-samples. The mean excess return for 1977-1992 is 0.762% per month, and is 0.825% for 1992-2017. The ratio of the variance of the two sub-samples follows an *F* distribution, and is used to test variance equality across the two sub-samples. The *F*-statistic of the difference in return volatility of the two sub-samples is 1.89, significant at the 1% level. The earlier sample period exhibits higher REIT return volatility. We construct a Satterthwaite t-statistic, appropriate for two samples with different variances, to test the equality of the mean return across the two sub-samples. The mean excess return of the All-REIT portfolio is insignificantly different in the two sub-sample periods. The residual returns also show no time-varying variance across the two sub-sample periods. This is supportive of the validity of our conditional expectation model, which assumes a constant variance on the residuals. The *F* and *t*-tests on the expected premium suggest higher variance in the first sub-sample but no difference in the means across the two sub-sample periods. Thus, our conditional expectation model captures the high REIT return volatility in the earlier sample period.

We now decompose the expected premium into the unconditional premium and latent premium, as follows:

$$\textit{Unconditional Premium}_{t+1} = a_{0i} + b_{0i} R_{p,\, t+1}, \qquad (5)$$

and

$$\textit{Latent Premium}_{t+1} = a'_{1i} Z_t + b'_{1i} Z_t \times R_{p,\, t+1}. \qquad (6)$$

The unconditional premium captures the constant risk loading over time, while the latent premium reflects the conditional risk loading. The last two rows of Table V report the *t* and *F*-tests on these two premium components. The unconditional premium for REITs averages 0.914% per month for 1977-1992, and 0.928% for 1992-2017. These two premiums are not significantly different (*t*-test), and the variances of the two sub-samples are not significantly different (*F*-test). In contrast, for the latent premium the variance is higher in the first sub-sample; the *F*-statistic is 12.88, significant at the 1% level. The latent premium averages -0.080% for 1977-1992, and -0.198% for 1992-2017. Consistent with the expected premium series, the two mean statistics are insignificantly different (*t*-test). The negative values of the two mean latent premiums suggest that the conditional risk loadings are inclined toward the downside. This is consistent with the usual observation that investors are more sensitive to downside risk.

We examine the expected, unconditional, and latent premiums. The unconditional premium captures most of the expected premium and exhibits persistent volatility over time. The latent premium is more volatile in the early sample period than in the later years. The latent premium is as high as 1.6% in June 1980 and October 1982, and as low as -1.6% in May 1981.

In the next section, we show that REITs are predictable for the time period 1977-1992 but not for 1992-2017. Table V suggests that the high volatility of the market may be responsible for the predictability of REITs in the 1970s and 1980s. Prior studies, such as Pesaran and Timmermann (1995), suggest that lagged conditioning variables may have predictive power on the stock market when volatility is high and/or when the economy is changing. These lagged variables do not exhibit significant predictive power for the stock market during quiet periods. Overall, the latent premium seems to be the predictable component of REIT returns.

4.5. In-sample Predictability

The preceding results suggest that the conditional expected (latent) premiums of REITs vary over time and the lagged conditioning variables, hb3, div, junk, term and T-bill predict the conditional expected premiums of REITs. This predictability is inferred under the framework of a robust multi-factor pricing model.

To examine the predictability of REIT returns directly, we regress REIT returns on the lagged conditioning variables:

$$R_{i,t+1} = a_{0i} + a'_{1i} Z_t + \square_{i,\, t+1}. \qquad (7)$$

Equation (7) is an abbreviated version of equation (2), excluding the risk factors. Table VI reports the regression results for the stock market and for grouped REIT portfolios for the full sample. For 1977-2017, four conditioning variables, hb3, div, term, and T-bill, have significant predictive power on the subsequent stock market returns. The *R*-squared is only 0.057, consistent with the usual level for such time series predictive models. For value-weighted REIT market returns, hb3, div and T-bill exhibit significant predictive power. Thus, the interest rate term structure has predictive power for the general stock market but not for the aggregate equity REIT market. Overall, the *R*-squared (0.063) of the value-weighted All-REIT portfolio is comparable to that of the stock market. For the equal-weighted REIT portfolio, in addition to the hb3, div, and T-bill factors, the junk yield also exhibits significant predictive power.

The regression results of the sub-groups of REITs generally show that the lagged conditioning variables predict REIT returns. Overall, REIT returns are predictable over the full sample period of 1977-2017.

To examine the time dependence of the predictability of REITs and to control for major changes in the REIT market, we divide the full sample into two groups: July 1977 - July 1992 and August 1992 – December 2017. Regression results are reported in Table VII. In Panel A, the results show that both the stock market and the REIT market are predictable for the period 1977-1992. The *R*-squareds for the regressions of the general stock market portfolio and the All-REIT portfolios (value- and equal-weighted) are consistently greater than those for the full sample (in Table VI). For the size and book-to-market portfolios, hb3, div, and T-bill exhibit significant predictive power, consistent with the results of the full sample.

Panel B reports the regression results for the second sub-sample 1992-2017. Surprisingly, only hb3 predicts the general stock market. None of the conditioning variables exhibit significant predictive power on the REIT portfolios. This result provides strong evidence that, for the more recent period, REITs are not predictable using the five conventional conditioning variables.

The results suggest that the predictability of REITs in the full sample is driven by predictability in the July 1977-July 1992 sample period. As discussed in the previous section, this predictability may be due to the latent component of the REIT risk premium. If this is the case, the predictability of REIT returns using these lagged variables is not inconsistent with market efficiency. Clearly, we do not posit that the five conventional conditioning variables we use are the only informative variables, or that the stock market and REIT market are not predictable in the more recent time period. However, consistent with Pesaran and Timmermann (1995) and Ling, Naranjo, and Ryngaert (2000), our results suggest that (1) REITs are less predictable in the more recent period (1992-2017), (2) different conditioning variables can be used for prediction in different time periods, and (3) the predictability of REIT returns is not constant over time.

5. Summary

Real estate is an important and unique sector in the equity market. The REIT market provides an opportunity to test asset pricing theory on real estate equities and permits comparison to the stock market. Using a large sample of equity REITs for the period 1977 through 2017, we document time-varying betas on the common risk loadings for REITs. This result is consistent with Ferson and Harvey's (1999) finding for stocks. Furthermore, the cross-section of REIT returns exhibits time-varying sensitivities to risk loadings. This result suggests that characteristics such as size and the book/market ratio are important determinants of REIT returns. In contrast to Ferson and Harvey's (1999) finding for stocks, we find no significant evidence of time-varying alphas in the REIT returns. This is consistent with the efficient market hypothesis.

Consistent with prior studies, we provide evidence that before 1992 REITs are predictable using latent variables. Using the same set of conditioning variables, this predictability fades in the period after 1992. Our results suggest that the predictability of REIT returns in the early sample period is due to the high market volatility and economic changes, which the conditional risk loadings capture under the conditional expectation model. Therefore, the previously documented predictability of REIT returns in the 1970s and 1980s using latent variables is not necessarily inconsistent with market efficiency. Our findings suggest that a conditional form of a risk factor model should be implemented when testing REIT pricing. Moreover, in testing the predictability of REITs, it is important to track different time periods.

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Table I. Summary Statistics

The sample period is from August 1977 to December 2017. All-REIT portfolios (value-weighted and equal-weighted) include all equity REITs in the merged COMPUSTAT and CRSP database with the necessary information for the calculation of the market capitalization and the book-to-market ratio. S1 (small), S2, and S3 (large) are three size-based portfolios of equity REITs. B1 (low), B2, and B3 (high) are three book-to-market based portfolios. Equity REITs are also divided into three groups according to size, and independently divided into three groups according to the book-to-market ratio. Nine portfolios (S1B1 – S3B3) are thus constructed. The value weighted stock market portfolio includes all domestic stocks (including REITs) in the NYSE/AMEX/NASDAQ. For the constructed portfolios, the mean, standard deviation, and autocorrelations of total monthly returns, cum dividend, are reported in percentage.

Portfolio	Mean	Std. Dev.	ρ_1	ρ_2	ρ_3	ρ_4	ρ_{12}	ρ_{24}
All-REIT value-weighted	1.299	4.574	0.119	-0.094	-0.045	0.006	0.097	-0.002
All-REIT equal-weighted	1.320	3.936	0.272	-0.078	-0.079	0.079	0.124	0.041
Stock Market	1.051	4.389	0.028	-0.070	-0.037	-0.055	0.001	0.084
S1	1.318	5.130	0.141	-0.052	-0.043	0.004	0.153	0.048
S2	1.378	5.426	0.059	-0.066	-0.034	-0.027	0.032	0.012
S3	1.190	4.810	0.155	-0.098	-0.093	0.013	0.132	-0.025
B1	1.161	5.014	0.132	-0.128	-0.095	-0.014	0.152	-0.007
B2	1.217	5.300	0.006	-0.020	-0.058	-0.021	0.019	0.027
B3	1.426	5.169	0.150	-0.059	0.013	0.043	0.061	-0.038
S1/B1	1.003	8.289	-0.043	-0.054	0.025	-0.025	0.093	0.035
S1/B2	1.515	6.375	0.016	0.067	-0.139	0.014	0.084	0.068
S1/B3	0.978	5.079	0.151	-0.057	-0.057	0.019	0.101	0.017
S2/B1	1.386	5.412	0.093	0.097	-0.115	-0.020	0.079	0.167
S2/B2	1.188	6.708	-0.066	-0.043	-0.039	-0.036	0.000	0.011
S2/B3	1.531	6.085	0.111	-0.091	0.024	0.022	0.069	-0.072
S3/B1	1.161	6.125	0.079	-0.185	-0.052	-0.029	0.159	-0.091
S3/B2	1.332	4.630	-0.002	-0.006	-0.025	-0.085	-0.044	0.058
S3/B3	1.492	6.322	-0.048	0.074	0.032	-0.042	0.129	0.068

Table II. The Fama-French Model on REITs

The All-REIT portfolios (value-weighted and equal-weighted) include all equity REITs in the merged COMPUSTAT and CRSP database that have the necessary information to calculate the market capitalization and the book-to-market ratio. Returns (%) are monthly, excess of the one-month T-bill rate, cum dividend. Parameter estimates in **bold** are significant at the 1% level, in ***bold*** and ***italic*** significant at the 5% level.

	Panel A: Full Sample (August 1977-December 2017)					
Portfolio	Constant	Market	SMB	HML	UMD	R^2
All-REIT	0.354	**0.565**	**0.468**	**0.377**		0.324
value-weighted	0.244	0.057	0.083	0.076		
All-REIT	0.228	**0.501**	**0.544**	**0.404**		0.516
equal-weighted	0.155	0.036	0.052	0.048		
All-REIT	0.107	**0.605**	**0.498**	**0.528**	**0.195**	0.343
value-weighted	0.254	0.057	0.082	0.090	0.064	
All REITs	0.017	**0.534**	**0.570**	**0.532**	**0.166**	0.550
equal-weighted	0.159	0.036	0.052	0.056	0.040	
	Panel B: Sub-sample (August 1977-July 1992)					
All-REIT	0.340	**0.705**	**0.676**	***0.310***		0.400
value-weighted	0.366	0.090	0.144	0.160		
All-REIT	-0.026	**0.624**	**0.782**	**0.378**		0.675
equal-weighted	0.197	0.049	0.077	0.086		
All-REIT	0.358	**0.707**	**0.675**	0.303	-0.020	0.400
value-weighted	0.380	0.091	0.144	0.165	0.109	
All-REIT	-0.001	**0.626**	**0.780**	**0.368**	-0.029	0.676
equal-weighted	0.205	0.049	0.078	0.089	0.059	
	Panel C: Sub-sample (August 1992-December 2017)					
All-REIT	0.445	**0.298**	**0.325**	**0.363**		0.293
value-weighted	0.261	0.061	0.077	0.065		
All-REIT	**0.617**	**0.266**	**0.373**	**0.369**		0.413
equal-weighted	0.202	0.047	0.060	0.050		
All-REIT	-0.023	**0.446**	**0.409**	**0.643**	**0.289**	0.379
value-weighted	0.269	0.067	0.075	0.089	0.068	
All-REIT	0.239	**0.386**	**0.440**	**0.595**	**0.233**	0.490
equal-weighted	0.207	0.052	0.058	0.069	0.052	

Table III. Testing on Time-Varying Betas in the Fama-French Framework

The dependent variables are monthly returns (%) of the set of portfolios, excess of the one-month T-bill rate and cum dividend. These returns are regressed on lagged instrumental variables, the returns of the Fama-French three-factor portfolios, the three-factor portfolio returns each multiplied by the instrumental variables, and a constant. The adjusted R-square of this regression is shown in the second column of the right panel. A restricted regression is estimated where the portfolio returns are regressed only on the three-factor portfolios, the lagged instruments, and a constant. The p-value of an F-test comparing the two R-squares is presented in the third column, as a test for time-varying betas. In the three columns of the left panel a similar experiment is conducted (constant alphas), in which the lagged instruments do not appear except as interaction terms. The three factors included are the market, SMB and HML. The lagged instrumental variables are hb3, div, junk, term and T-bill. The sample period is August 1977 through December 2017. S1 refers to the smallest third of the market capitalization, S3 is the largest third, B1 refers to the lowest third of the book/market ratios, and B3 is the highest third. #<0.05 is the number of p-values less than 0.05.

	Constant Alphas			Time-Varying Alphas		
Portfolio	R^2 Constant Betas	R^2 Time-Varying Betas	F-test (p-value)	R^2 Constant Betas	R^2 Time-Varying Betas	F-test (p-value)
All Value-weighted	0.324	0.374	**0.001**	0.336	0.379	**0.002**
All Equal-weighted	0.526	0.618	**0.001**	0.542	0.628	**0.001**
S1	0.435	0.533	**0.001**	0.439	0.537	**0.001**
S2	0.381	0.407	***0.022***	0.406	0.423	0.136
S3	0.136	0.161	0.119	0.148	0.169	0.176
B1	0.051	0.058	0.786	0.064	0.070	0.857
B2	0.371	0.429	**0.001**	0.397	0.423	***0.025***
B3	0.364	0.421	**0.001**	0.383	0.432	**0.001**
S1/B1	0.283	0.378	**0.001**	0.290	0.379	**0.001**
S1/B2	0.270	0.379	**0.001**	0.274	0.390	**0.001**
S1/B3	0.189	0.210	0.151	0.205	0.216	0.528
S2/B1	0.278	0.338	**0.001**	0.297	0.354	**0.001**
S2/B2	0.284	0.325	**0.004**	0.312	0.337	0.057
S2/B3	0.291	0.330	**0.005**	0.300	0.335	***0.012***
S3/B1	0.330	0.378	**0.001**	0.343	0.390	**0.001**
S3/B2	0.340	0.406	**0.001**	0.371	0.424	**0.001**
S3/B3	0.295	0.376	**0.001**	0.309	0.385	**0.001**
# < 0.05			8			7

Table IV. Testing on Time-Varying Alphas in the Fama-French Framework

The first column shows the average annualized intercept (monthly figure x 12, in percentage) in a regression of the portfolio excess returns on a constant and the three Fama-French factors. The second column presents the right-tailed p-value of a heteroskedasticity consistent test of whether the intercept is equal to zero. The third column reports the p-value of an F-test of whether the intercept is constant in a model with constant betas. The fourth column reports the p-value of a t-test of the hypothesis that the intercept is constant in the model with time-varying betas. The alternative for the constant alpha tests is to model the alphas as linear functions of the lagged instrumental variables. The lagged instrumental variables are hb3, div, junk, term and T-bill. The sample period is August 1977 through December 2017. S1 refers to the smallest third of the market capitalization, S3 is the largest third, B1 refers to the lowest third of the book/market ratios, and B3 is the highest third. #<0.05 is the number of p-values less than 0.05.

Portfolio	Annual Intercept (Constant alphas, constant beta)	Test Zero Unconditional Alpha	Test Constant Alpha (Constant betas)	Test Constant Alpha (Time-varying betas)
Total Value-weighted	4.249	0.074	0.369	0.768
Total Equal-weighted	2.730	0.071	0.068	0.174
S1	1.423	0.280	0.831	0.804
S2	4.583	***0.019***	0.029	0.168
S3	6.228	0.115	0.521	0.671
B1	10.655	0.120	0.524	0.590
B2	4.154	***0.048***	0.032	0.186
B3	0.430	0.432	0.105	0.351
S1/B1	5.388	***0.036***	0.719	0.998
S1/B2	2.300	0.277	0.900	0.344
S1/B3	-4.224	0.153	0.288	0.811
S2/B1	5.638	***0.021***	0.146	0.212
S2/B2	2.618	0.176	***0.036***	0.383
S2/B3	2.611	0.203	0.515	0.779
S3/B1	0.377	0.457	0.282	0.306
S3/B2	3.482	0.104	***0.015***	0.108
S3/B3	0.655	0.419	0.282	0.523
# < 0.05		2	2	0

Table V. Latent Risk Premium of Equity REITs

Mean and variance tests are conducted on the returns of the value-weighted All-REIT portfolio. The sample is divided into two sub-samples: August 1977 – July 1992 and August 1992 – December 2017. The first two columns report the mean of the total returns, residuals, expected premium, unconditional premium, and latent premium of the two sub-samples. The third column reports the difference in the mean. Satterthwaite t-statistics of the difference are reported in the fourth column and F-statistics on the variance of the two sub-samples are reported in the last column. p-values are reported in the parentheses. The t-statistics marked with † use the pooled method since the variances in the two sub-samples are insignificantly different (from the F-test).

	(1) 1977-1992	(2) 1992-2017	(1) - (2)	T-test	F-test
Total Return	0.762	0.825	-0.063	-0.13 (0.894)	**1.89** (<0.001)
Residuals	-0.072	0.094	-0.166	-0.51† (0.608)	1.19 (0.277)
Expected Premium	0.834	0.730	0.104	0.31 (0.760)	**3.61** (<0.001)
Unconditional Premium	0.914	0.928	-0.014	-0.08† (0.934)	1.02 (0.903)
Latent Premium	-0.080	-0.198	0.118	0.59 (0.554)	**12.88** (<0.001)

Table VI. In-Sample Predictability of Stock and REITs Portfolios: 1977-2017

The dependent variables are the excess returns of a set of portfolios. The explanatory variables are the lagged conditioning variables. The market portfolio includes all stocks in the NYSE/AMEX/NASDAQ, and is provided by Kenneth French. The All-REIT portfolios (value- and equal-weighted) include all equity REITs in the merged COMPUSTAT and CRSP database that have sufficient information to calculate the market capitalization and the book-to-market ratio. S1 (small), S2 (median), and S3 (large) are three size-based portfolios. B1 (low), B2 (median), and B3 (high) are three book-to-market based portfolios. S1/B1-S3/B3 are 9 portfolios based on size and the book-to-market ratio. Equity REIT portfolios are annually rebalanced based on size and the book-to-market ratio, as of the end of each July. Returns (%) are monthly, excess of the one-month T-bill rate, cum dividend. The sample period spans August 1977-December 2017. Standard errors are reported below estimates. Parameter estimates in **bold** are significant at the 1% level, in ***bold*** and ***italic*** are significant at the 5% level.

	Variables							
	constant	hb3	div	junk	term	T-bill	Autocorr	R^2
Market	1.641	**0.658**	**0.702**	1.148	***-0.682***	**-0.593**	-0.039	0.057
	0.906	0.215	0.282	0.883	0.303	0.172	0.057	
All REITs value-weighted	1.077	**0.647**	**0.900**	1.092	-0.578	**-0.578**	0.068	0.063
	1.119	0.248	0.347	1.081	0.370	0.208	0.057	
All REITs equal-weighted	0.973	**0.666**	***0.502***	***1.674***	-0.434	**-0.517**	0.076	0.100
	0.838	0.184	0.260	0.808	0.277	0.155	0.057	
S1	0.868	**0.613**	0.532	1.360	-0.397	**-0.477**	0.001	0.050
	0.962	0.223	0.299	0.935	0.321	0.181	0.057	
S2	1.039	***0.472***	***0.690***	**2.253**	***-0.634***	**-0.644**	***0.114***	0.103
	0.898	0.191	0.278	0.863	0.295	0.165	0.056	
S3	1.255	0.679	***1.221***	0.092	-0.657	-0.554	0.052	0.032
	1.751	0.392	0.544	1.694	0.581	0.327	0.057	
B1	1.074	0.460	***1.946***	-1.014	-0.695	-0.626	0.039	0.020
	2.904	0.656	0.902	2.812	0.964	0.543	0.057	
B2	1.157	**0.893**	0.498	***1.850***	***-0.655***	**-0.517**	0.004	0.080
	0.914	0.211	0.284	0.888	0.304	0.172	0.057	
B3	1.337	**0.573**	0.556	**2.308**	***-0.692***	**-0.667**	0.068	0.078
	0.986	0.218	0.306	0.952	0.326	0.183	0.057	
S1/B1	1.004	**0.696**	***0.710***	0.086	-0.240	***-0.379***	-0.044	0.041
	1.011	0.241	0.315	0.985	0.338	0.192	0.057	
S1/B2	0.664	0.399	0.239	1.835	-0.229	-0.380	-0.084	0.024
	1.269	0.309	0.396	1.241	0.426	0.242	0.057	
S1/B3	0.717	**1.049**	0.449	***2.875***	-0.755	**-0.694**	***-0.143***	0.072
	1.181	0.296	0.369	1.159	0.398	0.227	0.056	
S2/B1	0.769	***0.595***	0.381	**2.536**	-0.479	**-0.526**	-0.069	0.069
	0.896	0.217	0.279	0.875	0.300	0.171	0.057	
S2/B2	1.144	**0.926**	***0.728***	1.385	-0.541	**-0.615**	0.014	0.089
	0.976	0.224	0.304	0.947	0.325	0.183	0.057	
S2/B3	0.851	0.322	0.649	***2.046***	-0.409	**-0.618**	0.083	0.053
	1.196	0.261	0.371	1.153	0.395	0.222	0.057	
S3/B1	1.049	**0.756**	**1.083**	0.845	-0.274	**-0.754**	***-0.106***	0.073
	1.129	0.278	0.352	1.105	0.379	0.216	0.056	
S3/B2	0.952	**1.054**	0.252	1.863	-0.513	***-0.415***	0.009	0.088
	0.998	0.230	0.310	0.969	0.332	0.188	0.057	
S3/B3	1.635	**0.778**	0.610	***2.069***	***-0.781***	**-0.684**	-0.002	0.058
	1.123	0.261	0.349	1.091	0.374	0.212	0.057	

Table VII. In-Sample Predictability of Stock and REITs Portfolios: Sub-samples

The dependent variables are the excess returns of a set of portfolios. The explanatory variables are the lagged conditioning variables. The market portfolio includes all stocks in the NYSE/AMEX/NASDAQ, and is provided by Kenneth French. The All-REIT portfolios (value- and equal-weighted) include all equity REITs in the merged COMPUSTAT and CRSP database that have sufficient information to calculate the market capitalization and the book-to-market ratio. S1 (small), S2 (median), and S3 (large) are three size-based portfolios. B1 (low), B2 (median), and B3 (high) are three book-to-market based portfolios. S1/B1-S3/B3 are 9 portfolios based on size and the book-to-market ratio. Equity REIT portfolios are annually rebalanced based on size and the book-to-market ratio, as of the end of each July. Returns (%) are monthly, excess of the one-month T-bill rate, cum dividend. The sample period in Panel A spans August 1977-July 1992, and in Panel B spans August 1992-December 2017. Parameter estimates in **bold** are significant at the 1% level, in ***bold*** and ***italic*** are significant at the 5% level.

Panel A: Sub-sample 1977-1992

	Variables							
	constant	hb3	div	junk	term	T-bill	Autocor r	R^2
Market	-0.817	***0.503***	0.977	1.489	-0.351	**-0.557**	-0.064	0.081
	2.272	0.232	0.544	1.060	0.445	0.187	0.076	
All REITs value-weighted	-3.803	***0.614***	**2.178**	0.270	-0.438	***-0.576***	0.051	0.098
	3.230	0.306	0.772	1.493	0.629	0.261	0.076	
All REITs equal-weighted	-3.539	**0.636**	**1.546**	1.578	-0.329	**-0.552**	0.006	0.154
	2.196	0.215	0.525	1.019	0.429	0.179	0.076	
S1	-3.992	***0.614***	**1.597**	1.473	-0.412	**-0.505**	-0.084	0.095
	2.594	0.268	0.621	1.211	0.508	0.214	0.076	
S2	-4.368	0.396	**2.028**	***1.960***	-0.460	**-0.703**	0.037	0.180
	2.228	0.213	0.533	1.030	0.434	0.180	0.076	
S3	-3.932	0.689	***2.746***	-1.353	-0.656	-0.524	0.041	0.050
	5.474	0.522	1.308	2.532	1.066	0.443	0.076	
B1	-6.707	0.467	***4.366***	-3.259	-0.852	-0.607	0.023	0.034
	9.347	0.903	2.235	4.331	1.822	0.759	0.076	
B2	-1.730	**0.903**	***1.186***	1.627	-0.676	***-0.513***	-0.024	0.132
	2.503	0.250	0.599	1.164	0.489	0.205	0.076	
B3	-2.454	***0.515***	***1.522***	2.068	-0.491	**-0.730**	0.034	0.125
	2.606	0.250	0.623	1.206	0.508	0.211	0.076	
S1/B1	-2.005	***0.740***	***1.676***	-0.741	-0.271	-0.405	-0.088	0.069
	2.938	0.304	0.704	1.372	0.576	0.242	0.076	
S1/B2	-5.291	0.343	1.439	2.240	-0.238	-0.402	***-0.164***	0.065
	3.559	0.382	0.853	1.668	0.699	0.296	0.075	
S1/B3	-4.425	**0.960**	1.037	**4.278**	-0.697	**-0.662**	**-0.209**	0.146
	3.012	0.329	0.722	1.415	0.593	0.251	0.074	
S2/B1	-2.803	***0.558***	***1.305***	***2.371***	-0.249	**-0.609**	***-0.152***	0.119
	2.402	0.256	0.576	1.125	0.472	0.200	0.075	
S2/B2	-5.077	**0.858**	**2.261**	1.044	-0.429	**-0.667**	-0.058	0.156
	2.607	0.265	0.624	1.215	0.510	0.214	0.076	
S2/B3	-5.004	0.192	***1.914***	1.791	0.047	***-0.638***	0.051	0.080
	3.330	0.316	0.796	1.539	0.648	0.269	0.076	
S3/B1	-4.873	0.659	**2.554**	0.245	0.149	**-0.808**	-0.134	0.105
	3.262	0.345	0.782	1.527	0.640	0.270	0.075	
S3/B2	-0.770	**1.071**	0.561	1.721	-0.472	-0.370	0.017	0.121
	2.860	0.278	0.684	1.326	0.558	0.232	0.076	
S3/B3	-0.807	***0.776***	1.412	1.714	-0.732	**-0.772**	-0.035	0.087
	3.143	0.315	0.752	1.463	0.615	0.257	0.076	

Panel B: Sub-sample 1992-2017

	Variables							
	constant	hb3	div	junk	term	T-bill	Autocorr	R^2
Market	4.936	**2.095**	1.039	-0.511	-1.111	-1.129	-0.012	0.071
	5.342	0.918	0.825	3.420	0.641	0.617	0.088	
All REITs value-weighted	-0.929	0.384	0.501	1.837	-0.107	-0.153	0.005	0.019
	4.411	0.752	0.684	2.828	0.530	0.510	0.088	
All REITs equal-weighted	-1.015	0.622	0.608	1.594	-0.034	-0.146	0.141	0.054
	4.029	0.645	0.645	2.611	0.490	0.465	0.087	
S1	-3.126	0.492	1.027	1.675	0.171	0.085	0.167	0.073
	4.422	0.699	0.714	2.873	0.540	0.510	0.086	
S2	-1.207	0.797	0.353	1.683	0.063	-0.066	0.116	0.041
	4.487	0.728	0.713	2.902	0.545	0.518	0.087	
S3	-0.822	0.266	0.494	1.816	-0.130	-0.159	-0.041	0.018
	4.557	0.792	0.701	2.912	0.546	0.526	0.088	
B1	-0.048	0.349	0.303	0.244	0.305	-0.140	-0.053	0.042
	4.462	0.779	0.685	2.849	0.534	0.515	0.088	
B2	-0.340	0.344	0.615	2.257	-0.403	-0.287	0.018	0.015
	4.457	0.756	0.693	2.860	0.537	0.515	0.088	
B3	-3.137	0.659	0.441	3.309	-0.107	0.084	0.067	0.021
	4.970	0.825	0.781	3.201	0.601	0.574	0.088	
S1/B1	-4.158	0.210	0.554	2.983	0.231	0.280	0.045	0.036
	4.017	0.674	0.628	2.583	0.485	0.464	0.088	
S1/B2	-6.371	0.459	1.276	3.058	0.462	0.463	0.159	0.076
	5.441	0.863	0.876	3.532	0.663	0.628	0.087	
S1/B3	5.916	0.760	1.209	-3.379	-0.523	-1.045	-0.109	0.062
	6.242	1.111	0.949	3.972	0.744	0.721	0.087	
S2/B1	-0.925	0.749	-0.113	1.480	0.196	0.065	0.102	0.036
	4.491	0.734	0.712	2.901	0.545	0.519	0.087	
S2/B2	-0.405	0.767	0.315	0.304	0.249	-0.055	0.037	0.032
	4.318	0.727	0.674	2.774	0.521	0.499	0.088	
S2/B3	-2.810	0.850	0.952	3.290	-0.203	-0.144	0.119	0.045
	5.367	0.869	0.854	3.472	0.652	0.620	0.087	
S3/B1	0.685	0.320	0.334	-0.415	0.347	-0.231	-0.093	0.053
	4.751	0.841	0.724	3.026	0.567	0.549	0.087	
S3/B2	-0.149	0.233	0.624	2.564	-0.536	-0.337	-0.021	0.016
	4.632	0.799	0.715	2.964	0.556	0.535	0.088	
S3/B3	-3.695	0.527	0.254	3.465	-0.009	0.236	0.018	0.016
	5.153	0.874	0.801	3.306	0.620	0.595	0.088	