What determines the systematic risk of REITs?

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Fundamental drivers of dependence in real estate securities returns

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Abstract

We analyse the empirical relationships between REIT firm fundamentals and the dependence structure between individual REIT and stock market returns. Our study differs significantly from prior work because we distinguish between the average systematic risk of REITs and their asymmetric risk in the sense of a disproportionate likelihood of joint negative return clusters between REITs and the stock market. Our approach enables us to identify those firm characteristics that enhance the defensive qualities of a REIT in general and that, conditional on a given level of systematic risk, improve a stock's ability to protect portfolio value particularly in a downturn. We find that firms with low systematic risk are typically small, with low short-term momentum, low turnover, high growth opportunities and strong long-term momentum. Holding systematic risk constant, the main driving forces behind disproportionate negative return clusters between REITs and the stock market are leverage and, to some extent, also short-term momentum. From a practical point of view, our results promote the construction of portfolios that are better able to withstand a downturn. Our findings also contribute to the wider debate around the effect of leverage on REIT equity performance. We provide novel evidence that leverage has an asymmetric effect on REIT return dependence that outweighs the extent to which it increases the average sensitivity of REIT equity to market fluctuations.

Key words: Portfolio Diversification, REITs, Real estate as an asset class, JEL Codes G11, G12

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We gratefully acknowledge financial support from RERI. Eva Steiner further acknowledges support from the Cambridge Endowment for Research in Finance.

1 Introduction

The recent global financial crisis has provided compelling evidence of unexpected and disproportionate joint declines in real estate and stock returns (Gordon, 2009). This was not a unique event. Clustering of poor returns occurs frequently in downturns, matters for portfolio performance and affects asset prices (Ang and Bekaert, 2002; Ang, Chen, and Xing, 2006; Longin and Solnik, 2001; Patton, 2009). A disproportionate likelihood of joint negative returns between REITs and stocks is inconsistent with the common characterisation of REITs as defensive securities because the returns of defensive stocks respond less than proportionally to market fluctuations, implying a CAPM beta of less than one (Chan, Hendershott, and Sanders, 1990; Glascock and Hughes, 1995; Howe and Shilling, 1990).

Asymmetric dependence, in the sense of disproportionate negative return clusters, is independent of linear dependence as measured by beta (see Figure 1). Therefore, the familiar beta coefficient contains little information on how an asset reacts to a significant market downturn. Selecting stocks into a portfolio based on a low level of beta alone is insufficient to construct robust portfolios that are able to weather a downturn. Effective stock selection requires the accurate identification of securities with low systematic risk (beta) and, simultaneously, a low likelihood of joint negative return clusters with stocks. In this study, we explore the fundamental firm-level drivers of of systematic risk (beta) as well as asymmetric dependence independently of each other. Our results provide new insights into the relationships between REIT returns and the stock market, and thus facilitate the construction and management of portfolios that are more robust to market downturns.

[Insert Figure 1 about here.]

We are not the first to go beyond beta estimates in studying the joint evolution of investment returns from real estate (securities), REITs and other asset classes. Prior research has established three stylised facts about the dependence patterns of real estate security returns with respect to the broader market. Benefits of diversification vary through time, they decrease in periods of higher uncertainty and they also tend to dissipate during bear markets. However, the literature has produced limited insight into the fundamental economic drivers of dependence patterns in security returns. We contribute to the literature by identifying those firm characteristics that are empirically associated with the strongest ex ante impact on linear dependence and the likelihood of negative return clusters with the broader stock market.

We study the firm-level fundamental determinants of linear dependence as measured by beta separately and independently of the drivers of asymmetric dependence separately using a simple test statistic based on exceedance correlations (Alcock and Hatherley, 2013; Hong, Tu, and Zhou, 2007). Our method is in contrast to previous explorations on asymmetric dependence such as GARCH modelling or Copula functions - GARCH models describe time- and/or state-varying correlations and are therefore, much like the CAPM beta, unable to capture any disproportionate likelihood of negative return clusters independently of beta (Zhou and Gao, 2012). Copula functions on the other hand provide a comprehensive view on dependence but are unable to distinguish between linear dependence and the drivers of disproportionate negative return clusters (Clayton, 1978; Kimeldorf and Sampson, 1975; Patton, 2006, 2009). As a result, our findings help evaluate and improve upon traditional portfolio management techniques which are focused on managing linear dependence only.

Lastly, we focus on the role of one firm characteristic in determining dependence patterns in particular, namely leverage. Theoretically, the relationship between leverage and equity returns is unambiguous. The expected return on equity increases in leverage (Brealey and Myers, 2003). However, the empirical evidence on the relationship between real estate securities returns and leverage is less clear. Consequently, Giacomini, Ling, and Naranjo (2014) identify a need for more research on the effect of leverage on the investment performance of real estate securities from the point of view of equity investors. We contribute to this question by examining the relationship between leverage and systematic risk as well as a disproportionate likelihood of negative return clusters with the stock market.

Empirically, we find that linear dependence and an increasing likelihood of return clustering between REITs and stocks are distinct aspects of joint return patterns. Our results suggest that both are significantly related to ex ante observable firm characteristics, but in different ways. Small stocks, with low short-term momentum and low turnover are associated with low systematic risk. So are stocks with a high market-to-book ratio and strong long-term momentum. Stock with strong short-term momentum appear to be at risk of poor return clusters with stocks, while investment growth promotes clustering of positive returns with stocks. We find some evidence that leverage increases linear dependence of REIT returns on stocks in the long run, but mostly exacerbates clustering of poor returns.

We proceed as follows. Section 2 summarises the related literature. Section 3 discusses our choice of dependence measures. Section 4 describes the data and method employed. Section 5 discusses our empirical findings. Section 6 concludes.

2 Related literature

The benefits of diversification associated with including real estate in a mixed-asset portfolio are typically established on the basis of low average historical correlations (Baum, 2002; Bond, Hwang, Mitchell, and Satchell, 2007; Georgiev, Gupta, and Kunkel, 2003). However, empirical evidence increasingly points towards time-variation in the dependence patterns that underly the benefits of diversification commonly ascribed to real estate. Clayton and MacKinnon (2001) find that the sensitivity of REIT returns to the returns on stocks, bonds and direct real estate varies through time and follows a cyclical pattern. Cotter and Stevenson (2006) report that the correlation between REITs and the stock market fluctuates around a significant positive trend as market integration increases over time. Case, Yang, and Yildirim (2012) provide evidence that structural breaks in the REIT history, such as the introduction of REITs into broader stock market indices, demarcate different correlation regimes.

Time-variation in dependence patterns is partly a function of the prevailing level of volatility in the market. Chong, Miffre, and Stevenson (2009) present evidence that the pairwise correlations between REITs and stocks as well as bonds respond positively to higher volatility in those markets; they find the opposite for the relationships with government securities and commodities. Liow, Ho, Ibrahim, and Chen (2009) extend this analysis to pairs of international listed real estate securities markets as well as the relationships with the corresponding national stock markets. They confirm the positive relationship between conditional correlations of listed real estate securities and stocks and the prevailing level of volatility. These findings suggest that not only are benefits of diversification time-variant, but they appear to dissipate in periods of higher uncertainty.

The second driver of time-variation in dependence patterns is the strength of the market. Early evidence suggests that REITs exhibit lower systematic risk in bear markets, suggesting that REITs are defensive stocks (Chan, Hendershott, and Sanders, 1990; Glascock, 1991; Glascock and Hughes, 1995; Glascock, Michayluk, and Neuhauser, 2004; Howe and Shilling, 1990). More recently however, a large number of studies report evidence of asymmetric dependence. Many authors find that conditional correlations of listed real estate securities with respect to various benchmarks including stocks, pairs of real estate securities indices, and pairs of listed versus unlisted real estate return indices, in the US and internationally, increase disproportionately more in response to negative return shocks than to positive return shocks (Fei, Ding, and Deng, 2010; Hiang Liow, 2012; Hoesli and Reka, 2013; Michayluk, Wilson, and Zurbruegg, 2006; Yang, Zhou, and Leung, 2012).

Moreover, several authors report a disproportionately high likelihood of joint negative return events between pairs of listed real estate market indices and between listed real estate and stocks (Dulguerov, 2009; Goorah, 2007; Hoesli and Reka, 2013; Knight, Lizieri, and Satchell, 2005; Zhou and Gao, 2012), especially following the onset of the sub-prime mortgage crisis in 2007 (Simon and Ng, 2009). These findings suggest that the benefits of diversification commonly associated with investments in real estate securities may be reduced substantially when they are most needed.

In summary, the empirical literature on dependence structures in the returns from listed real estate securities to date has established three stylised facts. Benefits of diversification vary through time, they decrease in periods of higher uncertainty and they also tend to dissipate during bear markets. However, the literature to date has produced limited insight into the fundamental economic drivers of dependence patterns between real estate securities (REITs) and stocks. A notable exception is Liow, Zhou, and Ye (2014), who recognise this gap in the literature and make a significant contribution towards filling it. They study the drivers of quarterly realised correlations between eight international listed real estate securities markets over the period 1995 to 2012. They relate the cross-sectional and time series variation in correlation between markets to a set of market-wide real estate variables including the return on the direct real estate market pairs, pairwise market size and volatility differentials, the influence of the existence of REITs, as well as a set of control variables capturing macroeconomic, stock market, institutional and crisis effects. In addition, they explore spillover effects and the influence of regime changes.

Liow, Zhou, and Ye (2014) is the study that is closest to ours. We share the motivating observation that the fundamental economic drivers of dependence patterns are insufficiently understood. However, our work differs from theirs in a number of ways. First, instead of exploring market-wide dependence patterns across pairs of international market indices, we focus on the individual firm level. Second, instead of examining macroeconomic influences on dependence patterns between real estate and stock markets, we focus on the influence of firm fundamentals on the dependence patterns between individual firm returns and the stock market, after controlling for broad real and monetary macroeconomic factors. Finally, instead of studying realised correlations, we focus on the drivers of the CAPM beta, a well-established measure of linear dependence that feeds directly into asset prices, and a novel measure of asymmetric dependence that allows us to explore the drivers of a disproportionate likelihood of joint negative return clusters. To our knowledge, our study is the first to explore the drivers of dependence patterns in the returns from individual real estate securities in this way.

3 Measuring dependence

Studying dependence between security returns means describing their joint distribution. The joint distribution of any two random variables can be approximated by a combination of a standard bivariate normal distribution, where dependence is fully captured by linear measures, such as co-variance, or the scaled version, correlation, and a potentially infinite number of higher-order co-moments, such as co-skewness and co-kurtosis.[1] This perspective on dependence patterns is useful as it allows us to conceptually split dependence into a linear component that informs traditional portfolio management strategies, and the higher-order components that receive increasing academic and investor interest.

In order to study the evolution of dependence between asset returns, we could employ multivariate GARCH models. By definition, multivariate GARCH models focus on describing correlations. Therefore, they fail to reflect the higher-order aspects of dependence that are arguably among the major drivers of the joint value declines across assets and asset classes during bear markets (Ang and Chen, 2002; Longin and Solnik, 1995, 2001). Zhou and Gao (2012) provide a lucid discussion of the benefits and shortcomings of relying on correlation as an all-purpose measure of dependence.

Alternatively, we could employ copula functions to study dependence. Copula functions provide a significantly more comprehensive view on dependence. However, copulas commonly rely on a small number of parameters that simultaneously determine the location, slope and shape of the joint distribution (Clayton, 1978; Kimeldorf and Sampson, 1975; Patton, 2006, 2009). The resulting description may thus be a poor approximation of the true distribution. Further, the parameters of the copula do not map to the individual moments of the joint distribution, and so copulas are unable to distinguish between correlations and any higher-order aspects of dependence. Any copula-based analysis is therefore of limited use in evaluating and improving upon traditional portfolio diversification strategies, which are focused on managing correlations.

In order to mitigate the shortcomings of these methods, we aim to study a set of two complementary measures of dependence. First, we examine linear dependence as measured by the CAPM beta, which has established intuitive meaning and is firmly grounded in financial theory. Second, we employ a recently developed measure of asymmetric dependence, the 'Adjusted J statistic' (Alcock and Hatherley, 2013). In combination, these two measures provide a comprehensive assessment of the dependence between security returns.

[1] This decomposition is commonly referred to as the Edgeworth series expansion. For more details, see Hall (1992).

The Adjusted J is closely related to the J statistic developed by Hong, Tu, and Zhou (2007), which is based on the exceedance correlations between the returns on two assets or portfolios. Longin and Solnik (2001) define the exceedance correlation at level ϑ as the conditional correlation between two variables when both register shocks of more than ϑ standard deviations from their means. Under the null hypothesis of no asymmetric dependence, i.e. no significant differences in the exceedance correlations in opposing regions of the joint distribution, the J statistic is given by:

$$J_\rho := T(\hat{\rho}^+ - \hat{\rho}^-)'\hat{\Omega}^{-1}(\hat{\rho}^+ - \hat{\rho}^-) \sim \chi^2_N, \tag{1}$$

where $\hat{\rho}$ are the exceedance correlations, T is the sample size, $\hat{\Omega}$ is the variance/covariance matrix and N is the number of exceedances. The greater the test statistic, the greater the departure from symmetry. However, the J statistic does not account for linear dependence and it is unable to indicate the direction of asymmetry. In order to mitigate these shortcomings, Alcock and Hatherley (2013) define the Adjusted J as follows:

$$J^{Adj} := \left[\operatorname{sgn}\left(\left[\hat{\rho}^+ - \hat{\rho}^-\right]\mathbf{1}\right)\right] T(\hat{\rho}^+ - \hat{\rho}^-)'\hat{\Omega}^{-1}(\hat{\rho}^+ - \hat{\rho}^-) \tag{2}$$

The addition of the sign function (Alcock and Hatherley, 2009) means that the statistic indicates the sign of the sum of the differences between positive and negative conditional correlations and hence indicates the direction of asymmetry. A positive (negative) test statistic indicates net upper (lower) tail dependence. This feature is useful as investors are arguably particularly concerned about lower tail dependence, that is, increasing conditional correlations and thus dissipating benefits of diversification during bear markets. Further, the arguments in the Adjusted J are not the raw or standardised return series but a transformation that controls for the level of linear dependence. After the transformation, all asset returns display identical betas of unity while the original linear dependence structure between the asset and the benchmark is controlled for. This feature is useful to evaluate and improve upon diversification strategies that traditionally focus only on linear dependence as measured by beta. In summary, the Adjusted J assesses the presence, direction and strength of asymmetric dependence after controlling for linear dependence as measured by the CAPM beta. As a result, the combination of the CAPM beta and the Adjusted J statistic allows us to comprehensively examine linear and higher-order components of dependence patterns separately in a robust manner.

4 Data and method

4.1 Data set

We analyse a sample of publicly listed US equity REITs as a proxy for real estate investment securities. We collect total return data, firm characteristic information and benchmark data on the return on the S&P500 from *SNL Financial*. Apart from firm characteristics, dependence patterns may also be influenced by macroeconomic regimes (Liow, Zhou, and Ye, 2014). We account for macroeconomic conditions using interest rate data and recession indicators. Data on the federal funds rate and the 10-year Treasury is obtained from the Federal Reserve Bank of St Louis's Economic Database. Information on the dates that demarcate macroeconomic regimes are obtained from the NBER.

We begin our analysis in 1993, the beginning of the modern REIT era as marked by the introduction of the UPREIT regime. We end the study period in 2013, the most recent full year of data available at the time of writing. Firms enter the sample when they first appear on *SNL* and leave the sample when they become inactive (acquired or defunct). Firm characteristic data is obtained on a quarterly frequency. Return data for the calculation of the dependence measures is collected on a daily frequency to reduce measurement errors and smoothing of dependence measures. The single-factor (CAPM) beta is obtained on a quarterly basis from firm-by-firm regressions of daily total returns on the S&P500 index. In order to obtain a robust estimate of the single-factor beta, we require firms to have more than 50 observations available in a given quarter. Firm-level beta measures are then matched to lagged firm characteristics to be observable by market participants. All variables in our analysis except binary variables are winsorised at the 1st and 99th percentiles to mitigate any undue influence of outliers. Figure 2 shows the evolution of the number of firms with complete observations in our sample over the study period. The final number of firm-quarters is 3,828 from an average of 55 firms per quarter.

[Insert Figure 2 about here.]

Table 1 summarises the firm characteristics of the sample REITs. The mean single-factor beta is 0.589 for the S&P500, consistent with the view the REITs are on average defensive stocks (Chan, Hendershott, and Sanders, 1990; Glascock and Hughes, 1995; Howe and Shilling, 1990) and thus implying that REITs offer some benefits of diversification (Baum, 2002; Bond, Hwang, Mitchell, and Satchell, 2007; Georgiev, Gupta, and Kunkel, 2003). The adjusted J-statistic is -0.184 on average, suggesting a slight tendency for REIT returns to cluster disproportionately with poor returns on the stock market.

As for the fundamental firm characteristics, market leverage is on average 0.44, consistent with the observation that REITs carry significant leverage (Barclay, Heitzman, and Smith, 2013). The mean market-to-book ratio is 1.204 and the mean log of firm size is 12.844, consistent with the view that REITs are small value stocks (Geltner and Miller, 2001). The 6-month (36-month) cumulative total return averages 0.071 (0.488) over the sample period. On average, a proportion of 0.295 of common REIT shares outstanding is traded each quarter. Investment growth averages 0.185 and profitability averages 0.072, both broadly consistent with Bond and Xue (2014) who study the role of investment-related factors on asset prices. The federal funds rate averages 3.167% over the study period and a proportion of 0.105 of observations fall into recessionary periods as defined by the NBER.

[Insert Table 1 about here.]

Figure 3 Panel (a) shows the evolution of quarterly mean firm-level single-factor beta estimates with respect to the S&P500 over time. From approximately 1995 onwards, the average REIT beta increases at a slow but steady pace over time, consistent with the view of increasing market integration that has been observed for international real estate and stock market indices (Liow, Zhou, and Ye, 2014). The measure then increases sharply surrounding the global financial crisis, consistent with the anecdotal observation that in a crisis, correlations approach one (Gordon, 2009). Single-factor beta estimates were also significantly more volatile during the crisis than during the remainder of the study period. Further, the 95% confidence interval around the mean estimate is larger at the beginning of the sample period from approximately 1993 to 1995, then reduces to around 25 basis points until 2004, after which it widens. Confidence intervals are wider especially during the crisis and reduce gradually thereafter. This evolution is consistent with our expectation that there is considerable cross-sectional firm-level variation in the sensitivity to swings in stock market returns and thus benefits of diversification.

Figure 3 Panel (b) shows the evolution of quarterly mean firm-level adjusted J-statistic estimates with respect to the S&P500. For most of the study period from 1993 to approximately 2005, the mean J-statistic oscillates with a cyclical pattern between zero and -1, suggesting no to slight levels of clustering of negative returns. Between 2005 and 2006, the peak of the boom prior to the financial crisis of 2008, the average J-statistic becomes increasingly positive reaching a peak of c. 1.5, suggesting disproportionate clustering of positive returns during this significant expansion phase for REITs. The measure then drops sharply during the global financial crisis, consistent with the observation of severe joint losses across asset classes including stocks and real estate securities (Gordon, 2009). After the end of the crisis, the mean adjusted J-statistic resumes its pre-crisis levels and cyclical pattern. Consistent with the single-factor beta, the 95% confidence interval around the mean estimate is larger at the beginning of the sample period and then reduces slightly over time. However, confidence intervals around the mean adjusted J-statistic are consistently wider than for the mean single-factor beta estimate, suggesting cross-sectional firm-level differences in dependence patterns in average linear dependence as well as the tendency to register joint negative returns with the stock market.

[Insert Figure 3 about here.]

4.2 Preliminary unconditional analysis

We begin to explore the relationships between firm characteristics and dependence measures using simple pairwise correlations. Table 2 presents the results. We find that, on an unconditional basis, the single-factor beta (S&P500) is slightly positively related to the adjusted J-statistic. The adjusted J-statistic is calculated based on filtered returns in order to avoid confounding the measurement of asymmetric dependence with linear dependence. Any remaining correlation between the two measures thus suggests that there are genuinely common drivers shared between the two distinct aspects of dependence, which is not due to double-counting in the calculation of the dependence measures. Overall, the top three covariates of both dependence measures are the interest rate, turnover, firm size. In relative terms, we find that linear dependence, as measured by the single-factor CAPM beta, is related to macroeconomic factors and firm characteristics to a similar degree. Asymmetric dependence more strongly related to firm characteristics, especially size, while the relationship with macroeconomic factors is relatively weaker. In conclusion, we find that firm characteristics matter for linear dependence (beta), and are also related to an increasing likelihood of joint negative returns between REITs and stocks.

[Insert Table 2 about here.]

In order to explore the cross-sectional relationships between firm characteristics and dependence measures further, we carry out an unconditional multivariate quintile analysis. Every quarter, we sort firms into quintiles according to their single-factor beta estimate and, separately, according to their adjusted J-statistic, both relative to the S%P 500 index. Quintile 1 contains the firm-quarters with the lowest values of the dependence measure. Quintile 5 contains the firm quarters with the highest values for the dependence measures. We tabulate the corresponding mean firm characteristics in each quintile and then test the hypothesis that these means differ significantly across the top and bottom quintiles.

[Insert Table 3 about here.]

This analysis allows us to identify the set of characteristics that firms with low systematic risk and, respectively, a ow tendency for negative return clusters with the stock market, have in common. For the analysis of the CAPM beta in Panel (a) of Table 3, the most defensive stocks are in quintile 1 (lowest beta measure). The most defensive stocks have a number of characteristics in common that confirm the findings from the pairwise correlation analysis. The most defensive stocks are simultaneously small, high-growth (high book-to-market ratio) firms that are less intensively traded. In contrast to the pairwise correlation analysis, we find no evidence that the difference in leverage is part of the characteristics that significantly distinguish low-beta from high-beta stocks. This finding may be due to the indirect control for time effects through the annual sorting procedure.

For the analysis of the adjusted J-statistic in Panel (b) of Table 3, the stocks with the highest likelihood of joint negative return clusters with stocks are in quintile 1 (lowest adjusted J-statistic). The stocks with the highest tendency to display lower tail dependence with the stock market also have number of characteristics in common. They are on average small and thinly traded. This unconditional observation suggests a trade-off between linear dependence and the likelihood of disproportionate joint negative return clusters. While small size and thin trading activity appear to be associated with low linear dependence, they simultaneously exacerbate asymmetric joint declines with the stock market. The second difference to the analysis of the CAPM beta is the role of leverage. In this multivariate setting, we find that leverage is significantly associated with a higher likelihood of joint negative return clusters. In other words, we find that leverage is not one of the characteristics that significantly distinguishes defensive stocks that exhibit a low degree of dependence on the stock market on average. However, our findings suggest that the level of indebtedness of a firm significantly exacerbates the likelihood of disproportionate joint negative returns. As a result, our finding suggests that leverage has an asymmetric impact on performance.

4.3 Empirical approach

In our main empirical analysis, we estimate the dependence measures as a function of our chosen set of firm characteristics and macroeconomic control variables. This regression analysis complements our unconditional multivariate analysis. It allows us to estimate the marginal impact of a change in any of the firm characteristics on the dependence measures of interest, holding all other firms characteristics and macroeconomic variables constant.

We estimate the following model using OLS:

$$\begin{aligned}DM_{it} = \gamma_0 + \gamma_1 MLEV_{i,t-1} + \gamma_2 MB_{i,t-1} + \gamma_3 LnSize_{i,t-1} + \gamma_4 RET6_{i,t-1} \\ + \gamma_5 RET36_{i,t-1} + \gamma_7 TO_{i,t-1} + \gamma_8 REINV_{i,t-1} + \gamma_9 ROAE_{i,t-1} \\ + \gamma_{10} FedFunds_{t-1} + \gamma_{11} Rec_t + \gamma_{12} DM_{it-1} + u_{it}\end{aligned} \tag{3}$$

where DM is the dependence measure, γ_0 is a constant and u_{it} is the residual.

Following the asset pricing literature, we include the following explanatory variables. Market leverage $MLEV$ (Bhandari, 1988) is measured as Total Debt divided by the Market Value of Assets (Total Assets minus Book Equity + Market value of Equity). Firm size $LnSize$ (Banz, 1981; Keim, 1983) is the natural logarithm of the Market Capitalisation. Market-to-book ratio MB (Rosenberg, Reid, and Lanstein, 1985; Stattman, 1980) is the Market Value of Assets divided by the book value of Total Assets. 6-month (36-month) return ($RET6$ and $RET36$) (DeBondt and Thaler, 1985; Jegadeesh and Titman, 1993) is the 6-month (36-month) cumulative total return. In addition, we control for stock turnover as a measure of liquidity (Acharya and Pedersen, 2005; Holmström and Tirole, 2001; Liu, 2006). The turnover ratio TO is quarterly Trading Volume divided by Common Shares Outstanding. Following the investment-based approach to asset pricing in real estate (Bond and Xue, 2014), we also control for real estate investment growth ($REINV$) and profitability, measured as return on average equity ($ROAE$). In order to control for macroeconomic conditions, we further include the federal funds rate ($FedFunds$) and the NBER business cycle indicator as a binary variable that equals one in a recession period (Rec).

All explanatory variables, with the exception of the recession indicator, are lagged by one period. The lag ensures that firm characteristics are observable by market participants prior to the period over which the dependence measure is generated. Consequently, our inference relates to the predictive content of the firm characteristics for the dependence patterns in security returns. In order to account for autocorrelation in dependence measures, we also include their first lags. We further control for property sector and quarter effects using binary variables.

Where DM in (3) refers to the single-factor beta with respect to the S&P 500 benchmark, this is obtained from collecting quarterly regression coefficients on the firm level generated in a first-stage estimation from daily data in an OLS model as follows:

$$TR_{it} = \beta_0 + \beta_1 Benchmark_t + u_{it} \tag{4}$$

where TR is the total return on firm i at day t, $Benchmark$ is the total return on the benchmark stock index at time t, β_0 is a constant, β_1 is the regression coefficient we collect from each quarterly regression to generate the dependent variable in (3), and u is the residual.

By construction, the dependent variables in (3) are subject to estimation error. Utilising the estimates as the dependent variable in a second-stage regression results in an estimated dependent variable bias. In order to mitigate this bias and enable valid inference, we follow the procedure proposed in Hornstein and Greene (2012) and weight all independent observations by the inverse of the variance of the dependent variable.

The frequency of financial time series observations raises the question of non-synchronous trading and its consequences on the accurate estimation of covariance and related measures of dependence. The phenomenon has been documented as early as Fisher (1966) who demonstrates that when the arrival of trades is random and therefore non-synchronous across assets, then return observations sampled at regular intervals are correlated with neighbouring returns on other assets even when the underlying relationship is purely contemporaneous, leading to a systematic under-estimation of covariance. However, Epps (1979) shows that the bias is severe only beyond the inter-hour level. Considering our daily frequency, we believe that our measurement of covariance is sufficiently accurate.

5 Results

5.1 Firm characteristics and average systematic risk

Table 4 presents the regression results for the single-factor beta with respect to the S&P500. Our model explains 71% of the total cross-sectional/time series variation in firm-level beta estimates in the full sample of 3,828 observations over the study period 1993-2013. The estimations for the recession period contains significantly fewer observations than the non-recession period (401 versus 3,427). However, the explanatory power of our model is higher in the recession period (0.87) than in the non-recession period (0.67).

[Insert Table 4 about here.]

We find that beta is positively related to firm size. Larger firms have a larger share of the market return and are thus more sensitive to market variation. This finding is robust across the different sub-periods and the coefficient is stable with an economic impact of c. 7 basis points on beta for a one standard deviation increase in logged firm size.

We also find that beta is inversely related to the market-to-book ratio. This finding suggests that firms with stronger growth opportunities are less sensitive to variation in the market return, implying that these growth opportunities are largely idiosyncratic and thus shift the total risk of the firm away from exposure to variation in the market. Further, the effect of growth opportunities on beta is numerically almost three times larger in the recessionary sub-period, suggesting that idiosyncratic growth opportunities, which shift firm risk away from the market, were especially valuable during this period of general market turmoil. The economic impact of a one standard deviation drop in the market-to-book ratio is an increase in beta by 2 basis points in the full study period, and 5 basis points in the recession period.

The evidence we find for the relationship between past (6-month and 36-month) returns and beta is mixed. 6-month returns are positively related to beta in the full and non-recessionary periods, while 36-month returns are inversely related to beta in these sub-periods. The reversal in the effects of short- and long-term momentum suggests that long-term cumulative returns to some extent reflect performance that is unrelated to the performance of the underlying market, but driven by idiosyncratic factors. Short-term performance on the other hand may be more driven by short-term trading activity, increasing quarterly beta estimates. These effects disappear in the recession periods, suggesting that their influence on REIT systematic risk is more relevant in benign market environments. In the full period, the economic impact of a one standard deviation increase in short-term momentum, or an equivalent reduction in long-term momentum, is an increase of approximately 1 basis point, respectively.

Our results suggest that the turnover ratio, measuring the proportion of shares outstanding that is traded in a quarter, is strongly positively related to beta. In other words, as a stock is traded more frequently, the sensitivity of its performance to the return on the mark increases. Frequent trading may be a signal of investors seeking short-term gains by following momentum, rather than investing for the long run on the basis of the fundamentals of the firm, thus linking the findings on momentum and trading volume. On average, the economic impact of a one standard deviation increase in turnover is an 8 basis points increase in systematic risk.

We find that beta estimates are significantly related to the macroeconomic factors. [2] This finding echoes our earlier observation that there is a significant negative unconditional correlation between interest rates and the systematic risk of REITs, and that systematic risk increased in recent recession periods. However, our findings also suggest that while macroeconomic factors may provide some guidance on the systematic risk of REITs, they are unable to supersede fundamental firm characteristic factors. In other words, our findings suggest that while the systematic risk of all REITs to some extent is influenced by macroeconomic conditions, REITs with the right fundamental characteristics, such as smaller size and higher (idiosyncratic) growth opportunities are able to withstand these conditions better and maintain lower systematic risk in a recession than others.

We also find evidence that there is a significant relationship between past values of beta and present values of beta, as the lag of beta is positive and significant in our regression results. However, while the recent history of systematic is a significant indicator of the present level of systematic risk, it does not replace or subsume the effect of fundamental and macroeconomic factors.

We do not find evidence for a strong relationship between leverage and systematic risk. The positive sign of the coefficient on leverage is intuitive but the value is not statistically significant. In theory, the effect of leverage on the sensitivity of the return on equity to variation in the return on the market is unambiguously positive (Brealey and Myers, 2003). As leverage increases, so does the exposure of equity to market fluctuations. However, the empirical relationship is less clear, as discussed succinctly in Giacomini, Ling, and Naranjo (2014). Our results suggest that leverage has no statistically significant impact on the one-period ahead measure of average systematic risk. However, the impact of leverage does pass the threshold for statistical significance in the longer run. When we consider the two-period ahead measure of beta, we find evidence consistent with the hypothesis that leverage increases average systematic firm risk (see Column (1) in Appendix A.1).

In summary, our results suggest that investors are able to form expectations about the average sensitivity of a firm's equity to variation in the return on the market, and thus the benefits of including a given stock in a portfolio, by assessing the firm's size and growth opportunities, its past performance and the intensity with which it is traded. Even in recession periods, the firm fundamentals size, market-to-book ratio and trading intensity maintain significant predictive power for firm-level systematic risk.

[2] Our findings are consistent across the policy rate (federal funds rate) and the market-determined interest rate (10-year Treasury rate).

5.2 *Firm characteristics and negative return clusters*

Table 5 presents the regression results for the adjusted J-statistic with respect to the S&P500. Our model explains 58% of the total cross-sectional/time series variation in firm-level J-statistic estimates in the full sample.

[Insert Table 5 about here.]

We find that leverage is significantly associated with a reduction in the adjusted J-statistic. A lower statistic implies a higher likelihood of negative return clusters with the market benchmark. As a result, higher leverage disproportionately exacerbates the risk of a joint decline in the returns on REITs and the stock market. Over the full study period, the economic impact of a one standard deviation increase in leverage is a 2 basis points drop in the adjusted J-statistic, which represents a 10% decline relative to the mean J-statistic in the sample firms. In the recessionary period, the economic impact increases to a 10 basis points drop in the J-statistic for a one standard deviation increase in leverage.

In combination with our analysis of the CAPM beta, our results suggest that, while leverage may not substantially increase the one-period ahead estimate of systematic risk of REITs on average, it has a statistically and economically significant impact on the risk of joint negative return clusters between REITs and the stock market. Our finding may help explain some of the inconclusive evidence on the impact of leverage on performance by highlighting the asymmetric nature of its effect. The economic magnitude of the effect of leverage also increases substantially during the recessionary sub-period. Therefore, our finding further adds to the empirical evidence on the short-term and long-term detrimental effects of leverage on REIT performance during and after the recent financial crisis of 2008 that is documented in Sun, Titman, and Twite (2014).

We find that the adjusted J-statistic is positively related to firm size in the full period and in the non-recessionary period. Our findings suggest a trade-off between average systematic risk and the risk of disproportionate joint return clusters in this respect. We find that larger firms carry higher systematic risk but that they are less likely to exhibit joint negative return clusters with stocks, suggesting that they hold portfolios which are more robust to downturns. This finding implies that stock selection according to firm size has to be sensitive to the expected market environment in order to make an effective contribution to portfolio management. From an economic point of view, as the log of firm size increases by one standard deviation, the J-statistic increases by 5 basis points, or 20% relative to the mean J-statistic in the full sample.

The evidence we find for the relationship between past (6-month and 36-month) returns and the adjusted J-statistic is consistent with the evidence for systematic risk on average in the full study period. Strong short-term momentum is associated with a drop in the J-statistic, i.e. it exacerbates a stock's tendency to exhibit joint negative return clusters with the market. On the other hand, strong long-term momentum is associated with an increase in the J-statistic, suggesting that it alleviates the risk of joint negative return clusters. These results are not evident in the recessionary sub-period, again consistent with the findings for beta, and potentially reflecting the smaller size of this sub-sample.

We find that the estimates of the J-statistic are less strongly related to the macroeconomic factors.[3] This finding reflects our earlier observation that the pairwise correlations between firm characteristics and the J-statistic are relatively strong than those with the macroeconomic variables.

In contrast to the analysis of beta, we find a significant relationship between real estate investment growth and the risk of joint negative return clusters. As investment growth increases, the likelihood of joint negative return clusters is reduced significantly. Our finding adds to the literature on the relevance of investment-related factors to REIT assets prices by establishing a link between those factors and asymmetry risks (Bond and Xue, 2014).

We also find evidence that there is a significant relationship between past values of beta and present values of the J-statistic, as the lag of beta is positive and significant in our regression results. However, while the recent history of systematic is a significant indicator of the present level of asymmetry risk, it does not replace or subsume the effect of fundamental and macroeconomic factors. The same is true for the lag of asymmetry risk itself. While our findings suggest a significant trend component in this measure, the firm characteristics are still statistically and economically meaningful predictors of the risk of joint negative return clusters between a REIT and the stock market.

In summary, our results suggest that investors are able to form expectations about the risk of a REIT to exhibit negative return clusters with the market, and thus the benefits of including a given stock in a portfolio, by assessing the firm's leverage, size as well as its investment growth and past performance. During recession periods, the most important predictors of a firm's likelihood to register joint return declines with the market are its leverage and investment growth metrics. Our findings are generally robust to a longer-term prediction horizon as well (see Column (2) in Appendix A.1).

[3] Our findings are consistent across the policy rate (federal funds rate) and the market-determined interest rate (10-year Treasury rate).

6 Conclusion

The literature suggests that the fundamental economic drivers behind the characterisation of REITs as defensive stocks are insufficiently understood. The gap in the literature relates to the firm-level drivers of average systematic risk as well as the drivers of a disproportionate likelihood of joint negative returns between a REIT and the stock market. These drivers are important, as they facilitate effective stock selection and risk management in investment portfolios. To the best of our knowledge, our study is the first to explore the fundamental firm characteristics of individual REITs that determine these two distinct but complementary aspects of dependence between their returns and the stock market.

We find that linear dependence and an increasing likelihood of return clustering between REITs and stocks are distinct aspects of return patterns. Both are important for asset prices and portfolio performance. Also, both are significantly related to firm characteristics. We find strong relationships between firm fundamentals and systematic risk as well as asymmetric risk that are unexplained by macroeconomic events, monetary policy regimes or trends in the risk measures themselves. While the influence of firm characteristics is somewhat reduced during recessionary periods, they remain significant. However, average systematic risk and asymmetric risk are related to firm characteristics in different ways.

Stocks with low systematic risk are typically small, with low short-term momentum, low turnover, high growth opportunities and strong long-term momentum. In order to reduce risk of negative returns clusters, robust portfolios should underweight stocks with strong short-term momentum. On the other hand, investment growth is associated with a lower likelihood of joint negative return clusters. Lastly, we find some evidence that leverage increases linear dependence of REIT returns on stocks in the longer run, but has an asymmetric impact and significantly exacerbates clustering of poor returns in the short and longer term. This last finding may help explain some of the conflicting evidence on the role of leverage in REIT performance from the point of view of equity investors by highlighting the asymmetric nature of leverage on risk.

Therefore, our results help guide managers in modulating the systematic risk of their firm, for instance by choosing the appropriate level of leverage for their firm. On the other hand, our findings also provide guidance for investors. Our results imply that investors are able to draw valid inferences about the future systematic and asymmetric risk profile of a REIT from observable firm characteristics. Overall, our findings assist managers and investors alike in assessing and managing the role of REIT stocks in mixed-asset portfolios.

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7 Figures and tables

Scatter plots for simulated returns on a broad stock market index (X_1) and a security (X_2)

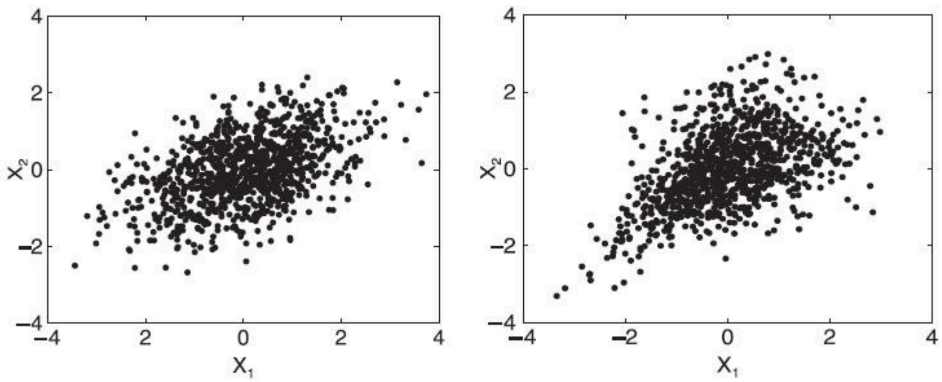


Fig. 1. The figure shows scatter plots of simulated data on the market (X_1) and a security (X_2) under two different assumptions about dependence patterns between the return series. The panel on the left shows an evenly spread, symmetrical distribution of returns whose dependence structure is fully captured by the familiar CAPM beta that measures the slope of a straight line through the scatter plot. The panel on the right shows an asymmetric distribution of returns with a disproportionate clustering of poor returns that leaves the slope of a straight line through the scatter plot largely unaffected.

Evolution of the number of sample firms

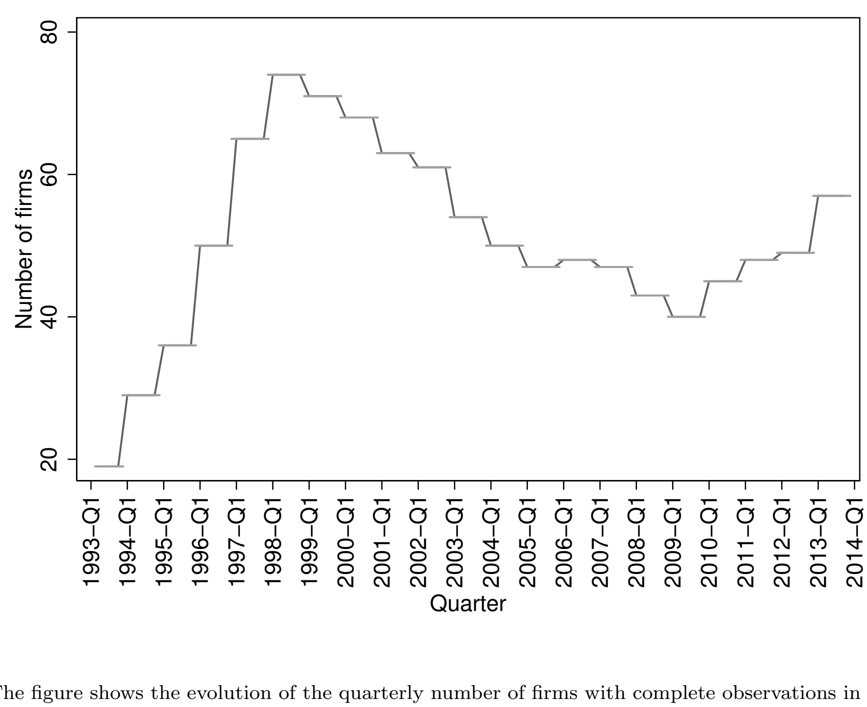
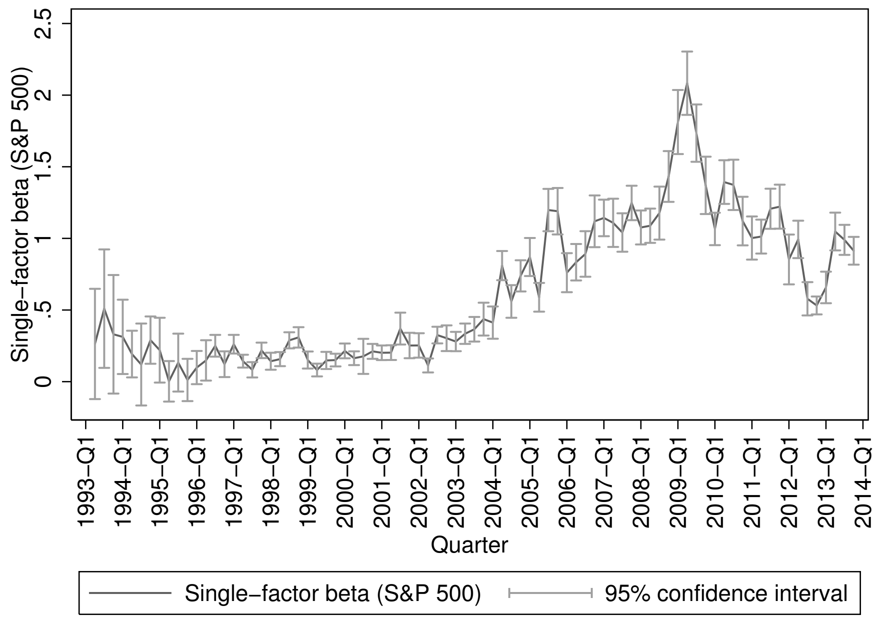
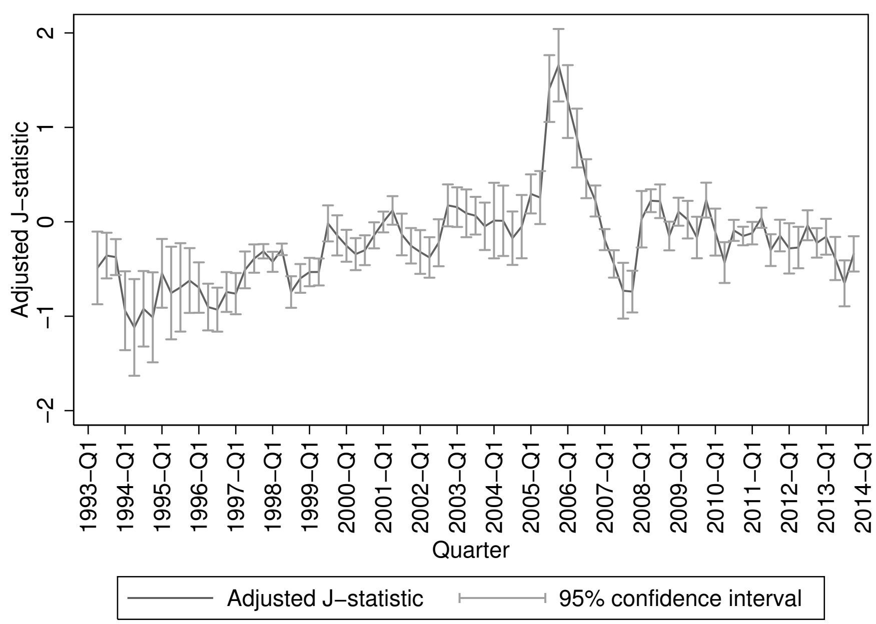


Fig. 2. The figure shows the evolution of the quarterly number of firms with complete observations in our sample over the study period 1993-2013.

Evolution of mean firm-quarter dependence measures



(a) Mean single-factor beta estimate



(b) Mean adjusted J-statistic

Fig. 3. The figure shows the evolution of quarterly mean firm-level single-factor beta estimates with respect to the S&P500 (Panel (a)) and the adjusted J-statistic (Panel (b)) over the period 1993 to 2013. Single-factor betas are obtained from quarterly firm-by-firm regressions of daily total returns on the S&P500 index. Quarterly Adjusted J-statistics are obtained from daily data on the respective REITs and the S&P500 index. The bars indicate a 95% confidence interval around the mean estimate.

Descriptive statistics

Variable	Mean	SD	P5	P25	Median	P75	P95
Single-factor beta	0.589	0.614	-0.183	0.157	0.423	1.001	1.696
Adjusted J-statistic	-0.184	0.886	-1.715	-0.413	-0.049	0.045	1.010
Market leverage	0.440	0.184	0.045	0.335	0.435	0.555	0.750
Market-to-book ratio	1.204	0.336	0.758	1.004	1.151	1.337	1.860
Log of firm size	12.844	1.835	9.071	11.904	13.165	14.186	15.261
6-month return	0.071	0.218	-0.269	-0.038	0.065	0.171	0.429
36-month return	0.488	0.716	-0.558	0.039	0.449	0.824	1.721
Turnover ratio	0.295	0.297	0.021	0.102	0.206	0.382	0.851
Real estate investment growth	0.185	0.518	-0.160	-0.024	0.035	0.187	1.045
Return on average equity	0.072	0.151	-0.090	0.031	0.071	0.109	0.241
Federal funds rate (%)	3.167	2.252	0.090	1.000	3.460	5.280	6.020
NBER recession periods	0.105	0.306	0.000	0.000	0.000	0.000	1.000

Table 1

The table presents the descriptive statistics on the sample firms. Single-factor betas are obtained from quarterly firm-by-firm regressions of daily total returns on the S&P500 index. Quarterly Adjusted J-statistics are obtained from daily data on the respective REITs and the S&P500 index. Market leverage is measured as Total Debt divided by the Market Value of Assets (Total Assets minus Book Equity + Market value of Equity). Firm size is the natural logarithm of the Market Capitalisation. Market-to-book ratio is the Market Value of Assets divided by the book value of Total Assets. 6-month return is the 6-month cumulative total return. 36-month return is the 36-month cumulative total return. Turnover ratio is quarterly Trading volume divided by Common Shares Outstanding. Real estate investment growth measures the rate of investment. Return on average equity measures profitability. All firm-level data and return data on the firms, the S&P500 and the Russell 2000 is obtained form *SNL Financial*. Data on the federal funds rate is obtained from the Federal Reserve Bank of St Louis's Economic Database and business cycle indicators are from NBER. The study period is 1993 to 2013. The total number of observations in the final sample is 3,828.

Pairwise Pearson correlation table

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Single-factor beta (S&P 500)	1											
(2) Adjusted J-statistic	0.1809*	1										
(3) Market leverage	0.0507*	-0.0272	1									
(4) Market-to-book ratio	0.1250*	0.0778*	-0.4044*	1								
(5) Log of firm size	0.4455*	0.2381*	-0.2765*	0.3959*	1							
(6) 6-month return	-0.0523*	-0.0490*	-0.1355*	0.1399*	0.0436*	1						
(7) 36-month return	-0.1318*	0.0487*	-0.3272*	0.3348*	0.1348*	0.3092*	1					
(8) Turnover ratio	0.6706*	0.1276*	0.1161*	0.0195	0.4502*	-0.1259*	-0.2029*	1				
(9) RE investment growth	-0.0621*	-0.0279	-0.0501*	0.0354*	-0.0221	-0.0174	0.0288	-0.1007*	1			
(10) ROAE	-0.0482*	0.0004	0.0193	-0.0338*	0.0024	-0.031	0.0086	-0.0598*	0.0206	1		
(11) Federal funds rate (%)	-0.4478*	-0.1080*	-0.0044	-0.1316*	-0.2882*	-0.0665*	0.0373*	-0.4534*	0.0977*	0.1027*	1	
(12) NBER business cycle indicator	0.1881*	0.0732*	0.1225*	-0.0706*	0.016	-0.1889*	-0.2035*	0.2656*	-0.0872*	-0.0051	-0.0047	1

Table 2: The table presents the pairwise Pearson correlation measures for the characteristics of the sample firms. Single-factor betas are obtained from quarterly firm-by-firm regressions of daily total returns on the S&P500 index. Quarterly Adjusted J-statistics are obtained from daily data on the respective REITs and the S&P500 index. Market leverage is measured as Total Debt divided by the Market Value of Assets (Total Assets minus Book Equity + Market value of Equity). Firm size is the natural logarithm of the Market Capitalisation. Market-to-book ratio is the Market Value of Assets divided by the book value of Total Assets. 6-month return is the 6-month cumulative total return. 36-month return is the 36-month cumulative total return. Turnover ratio is quarterly Trading volume divided by Common Shares Outstanding. Real estate investment growth measures the rate of investment. Return on average equity measures profitability. All firm-level data and return data on the firms, the S&P500 and the Russell 2000 is obtained form *SNL Financial*. Data on the federal funds rate is obtained from the Federal Reserve Bank of St Louis's Economic Database and business cycle indicators are from NBER. The study period is 1993 to 2013. The total number of observations in the final sample is 3,828. The asterisks indicate significance at the 5% level.

Unconditional quintile analysis for covariates of dependence measures

Panel (a): CAPM Beta	1	2	3	4	5	Difference	(t-statistic)
Market leverage	0.462	0.417	0.422	0.421	0.477	0.015	(1.43)
Log of firm size	11.647	12.982	13.322	13.393	12.895	1.248***	(13.14)
Market to book ratio	1.186	1.219	1.245	1.226	1.145	-0.0413*	(-2.24)
6-month return	0.077	0.074	0.073	0.062	0.071	-0.005	(-0.40)
36-month return	0.482	0.492	0.521	0.526	0.419	-0.0624	(-1.52)
Turnover ratio	0.198	0.289	0.312	0.333	0.342	0.144***	(9.37)
RE investment growth	0.209	0.171	0.176	0.171	0.196	-0.012	(-0.43)
ROAE	0.064	0.071	0.081	0.076	0.070	0.006	(0.78)

Panel (b): J-statistic	1	2	3	4	5	Difference	(t-statistic)
Market leverage	0.470	0.437	0.436	0.430	0.425	-0.045***	(-4.60)
Log of firm size	12.408	12.879	13.008	12.971	12.960	0.552***	(5.78)
Market to book ratio	1.178	1.201	1.209	1.222	1.211	0.033	(1.91)
6-month return	0.080	0.069	0.076	0.069	0.062	-0.018	(-1.55)
36-month return	0.439	0.471	0.525	0.510	0.495	0.056	(1.50)
Turnover ratio	0.266	0.297	0.315	0.296	0.301	0.0349*	(2.38)
RE investment growth	0.191	0.176	0.194	0.173	0.189	-0.003	(-0.10)
ROAE	0.072	0.074	0.074	0.070	0.072	-0.001	(-0.10)

Table 3

The table presents the results from the unconditional quintile analysis of the covariates of the dependence measures. Quintiles are formed by sorting firms into quarterly groups according to the value of their respective dependence measures. In Panel (a), single-factor betas are obtained from quarterly firm-by-firm regressions of daily total returns on the S&P500 index. In Panel (b), quarterly Adjusted J-statistics are obtained from daily data on the respective REITs and the S&P500 index. Market leverage is measured as Total Debt divided by the Market Value of Assets (Total Assets minus Book Equity + Market value of Equity). Firm size is the natural logarithm of the Market Capitalisation. Market-to-book ratio is the Market Value of Assets divided by the book value of Total Assets. 6-month return is the 6-month cumulative total return. 36-month return is the 36-month cumulative total return. Turnover ratio is quarterly Trading volume divided by Common Shares Outstanding. Real estate investment growth measures the rate of investment. Return on average equity measures profitability. $L.Beta$ is the first lag of the single-factor beta. All firm-level data and return data on the firms and the S&P500 is obtained form $SNL\ Financial$. Data on the federal funds rate is obtained from the Federal Reserve Bank of St Louis's Economic Database and business cycle indicators are from NBER. Difference indicates the difference in the mean characteristic values across the 1^{st} and 5^{th} quintiles of the dependence measures. The corresponding t-statistics are shown in parentheses. Significance is indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

Regression results for single-factor beta with respect to S&P 500 index

VARIABLES	(1) Full period	(2) Recession	(3) Non-recession
Market leverage	0.043	0.174	0.046
	(0.04)	(0.12)	(0.04)
Log of firm size	0.043***	0.059***	0.043***
	0.00	(0.01)	0.00
Market to book ratio	-0.066***	-0.168**	-0.061***
	(0.02)	(0.07)	(0.02)
6-month return	0.063*	0.122	0.069*
	(0.03)	(0.08)	(0.04)
36-month return	-0.024**	-0.013	-0.025**
	(0.01)	(0.04)	(0.01)
Turnover ratio	0.345***	0.378***	0.270***
	(0.03)	(0.06)	(0.04)
RE investment growth	0.009	-0.061	0.01
	(0.01)	(0.04)	(0.01)
ROAE	-0.005	0.075	-0.029
	(0.04)	(0.08)	(0.04)
Federal funds rate (%)	-0.094***	-0.125***	-0.113***
	(0.02)	(0.02)	(0.02)
NBER business cycle indicator	0.231***	n/a	n/a
	(0.08)	n/a	n/a
L.beta	0.350***	0.513***	0.333***
	(0.02)	(0.05)	(0.02)
Constant	0.138	0.068	0.223**
	(0.10)	(0.25)	(0.11)
Observations	3,828	401	3,427
R-squared	0.709	0.870	0.665
Sector effects	Yes	Yes	Yes
Quarter effects	Yes	Yes	Yes

Table 4
The table presents the regression results for the firm-quarter observations of the single-factor beta with respect to the S&P500. The single-factor beta is obtained from quarterly firm-by-firm regressions of daily total returns on the S&P500 index. The lag of beta is included as a control variable. Market leverage is measured as Total Debt divided by the Market Value of Assets (Total Assets minus Book Equity + Market value of Equity). Firm size is the natural logarithm of the Market Capitalisation. Market-to-book ratio is the Market Value of Assets divided by the book value of Total Assets. 6-month return is the 6-month cumulative total return. 36-month return is the 36-month cumulative total return. Turnover ratio is quarterly Trading volume divided by Common Shares Outstanding. Real estate investment growth measures the rate of investment. Return on average equity measures profitability. *L.Beta* is the first lag of the single-factor beta. All firm-level data and return data on the firms and the S&P500 is obtained form *SNL Financial*. Data on the federal funds rate is obtained from the Federal Reserve Bank of St Louis's Economic Database and business cycle indicators are from NBER. Standard errors, shown in parentheses, are robust to the estimated dependent variable bias, using the weighting procedure proposed in Hornstein and Greene (2012). Significance is indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

Regression results for adjusted J-statistic with respect to S&P 500 index

	(1)	(2)	(3)
VARIABLES	Full period	Recession	Non-recession
Market leverage	-0.134**	-0.590***	-0.080
	(0.07)	(0.22)	(0.07)
Log of firm size	0.027***	-0.014	0.028***
	(0.01)	(0.03)	(0.01)
Market to book ratio	-0.058	0.110	-0.069*
	(0.04)	(0.13)	(0.04)
6-month return	-0.227***	-0.054	-0.262***
	(0.06)	(0.15)	(0.06)
36-month return	0.037**	0.052	0.036*
	(0.02)	(0.08)	(0.02)
Turnover ratio	-0.031	0.158	-0.054
	(0.06)	(0.11)	(0.07)
RE investment growth	0.042**	0.208**	0.033*
	(0.02)	(0.08)	(0.02)
ROAE	0.002	0.131	-0.042
	(0.06)	(0.14)	(0.07)
Federal funds rate (%)	0.002	0.067*	0.000
	(0.03)	(0.04)	(0.03)
NBER business cycle indicator	0.624***		
	(0.13)		
L.beta	0.046*	0.067	0.046
	(0.03)	(0.08)	(0.03)
L.jstat	0.636***	0.545***	0.638***
	(0.01)	(0.05)	(0.01)
Constant	-0.479***	0.175	-0.433**
	(0.17)	(0.45)	(0.19)
Observations	3,828	401	3,427
R-squared	0.584	0.371	0.598
Sector effects	Yes	Yes	Yes
Quarter effects	Yes	Yes	Yes

Table 5

The table presents the regression results for the firm-quarter observations of the adjusted J-statistic with respect to the S&P500. The lags of the J-statistic and the single-factor beta are included as a control variable. Market leverage is measured as Total Debt divided by the Market Value of Assets (Total Assets minus Book Equity + Market value of Equity). Firm size is the natural logarithm of the Market Capitalisation. Market-to-book ratio is the Market Value of Assets divided by the book value of Total Assets. 6-month return is the 6-month cumulative total return. 36-month return is the 36-month cumulative total return. Turnover ratio is quarterly Trading volume divided by Common Shares Outstanding. Real estate investment growth measures the rate of investment. Return on average equity measures profitability. *L.Beta* is the first lag of the single-factor beta. All firm-level data and return data on the firms and the S&P500 is obtained form *SNL Financial*. Data on the federal funds rate is obtained from the Federal Reserve Bank of St Louis's Economic Database and business cycle indicators are from NBER. Standard errors, shown in parentheses, are robust to the estimated dependent variable bias, using the weighting procedure proposed in Hornstein and Greene (2012). Significance is indicated as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Appendices

A Two-period ahead regressions

Regression results for two-period ahead beta and adjusted J-statistic with respect to S&P 500 index

	(1)	(2)
VARIABLES	F.Beta	F.J-statistic
Market leverage	0.072*	-0.220***
	(0.04)	(0.08)
Log of firm size	0.053***	0.046***
	0.00	(0.01)
Market to book ratio	-0.099***	-0.083*
	(0.02)	(0.05)
6-month return	0.039	-0.348***
	(0.03)	(0.07)
36-month return	-0.017	0.061***
	(0.01)	(0.02)
Turnover ratio	0.358***	0.032
	(0.04)	(0.07)
RE investment growth	0.012	0.008
	(0.01)	(0.02)
ROAE	0.028	0.011
	(0.04)	(0.08)
Federal funds rate (%)	-0.017	-0.173***
	(0.02)	(0.03)
NBER business cycle indicator	0.271***	0.928***
	(0.08)	(0.16)
L.beta	0.317***	-0.02
	(0.02)	(0.03)
L.jstat	n/a	0.385***
	n/a	(0.02)
Constant	-0.318***	-0.109
	(0.10)	(0.21)
Observations	3,735	3,723
R-squared	0.704	0.419
Sector effects	Yes	Yes
Quarter effects	Yes	Yes

Table A.1
The table presents the regression results for the firm-quarter observations of the two-period ahead single-factor beta with respect to the S&P500 (Column (1)) and the adjusted J-statistic (Column (2)). Variables are defined as in the main analysis. Significance is indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.