The Determinants of REIT Volatility

Lingxiao Li[*†]

This Draft: April, 2012

Abstract

This paper focuses on how market risk, economic activities, financial leverage, inflation shocks and trading activities affect REIT return volatility using U.S equity REITs data from 1995 to 2009. The findings suggest that systematic risk positively affects REIT return volatility, with a higher impact in up markets than in down markets. Dividend Yield (DY) and Return On Average Equity (ROAE) negatively affect REIT return volatility in up markets. Use of firm leverage increases REIT return volatility due to the scaling effect of leverage on return dynamics. Loan type matters, with a positive impact of short-term debt use on volatility, possibly capturing roll over risk of short-term debt. Unexpected inflation results in higher REIT return volatility, with larger impacts in down markets and for property sector utilizing short-term lease strategies. A positive correlation exists between trading volume and REIT return volatility, suggesting that increased trading induces REIT return volatility. REIT-ETF constituent stocks feature higher return volatility than non index stocks during the recent financial and housing crisis.

[*]Graaskamp Center for Real Estate, Wisconsin School of Business, University of Wisconsin-Madison, 975 University Avenue Madison, WI 53706. Email: lingxiaoli@bus.wisc.edu

[†]The author wishes to thank David Barker, Brad Case, Mike Grupe, Pagliari Joseph, Kevin Lindemann, Timothy Riddiough and Lawrence Souza for helpful comments and is grateful to the Real Estate Research Institute for research funding. All remaining errors are, of course, my own.

Keywords: REIT, Volatility, Market Risk, Leverage, Inflation, Trading

1 Introduction

In recent years, Real Estate Investment Trust (REITs) has featuredve experienced dramatically high return volatility. Prior to 2004, REIT stock return volatility was lower than common stock return volatility. After 2004, REIT stock return volatility rose over time and was doubled that of common stock by 2008. Exacerbated volatility levels serve as a tax to firms, due to the increasing cost to debt/equity capital, that negatively affects REIT firm values, and capital flows to the whole commercial real estate market.

Over the past 50 years, many researchers have studied movements in aggregate stock market volatility. Leroy and Porter (1981) and Roll (1988) show that stock price volatility cannot be explained solely by changes in economic and market fundamentals. However, Schwert (1989) relates stock return volatility with macroeconomic volatility, economic activity, financial leverage and finds that stock return variability is unusually high during the great depression. There have been many attempts to relate changes in stock return volatilities to changes in trading activities. Wang (1994) predicts a positive relation between volume and absolute changes in prices and dividends, using a model of competitive stock trading by heterogeneous investors. Karpoff (1987) cites 18 separate studies that document this relation in a variety of financial markets. Karpoff argues that price changes reflect the market evaluation of new information, while volume is an indicator of the degree to which investors disagree with the meaning of information. Different interpretations of new information forced various response to new information, leading to price changes in the market. Determinants of time-series return behavior are open to debate, according to Campbell et al. (2001) and Wei and Zhang (2006).

Studies on stock return volatility, in the context to the real estate market, is still limited and under debate. In recent literature, Exchange Traded Funds (ETFs) are largely blamed for increased volatility, due to using high leverage and increasing the trading activities of REITs. Lu, Wang, and Zhang (2009) document the extent of rebalancing necessary at the end of each day (or early in the next day) for the funds to achieve their desired exposure to track the benchmark. This kind of rebalancing has major impacts that exacerbate volatility, because these funds have significant assets under management and have to rebalance in the same direction at day's end, increasing stock return volatility in the process. Boney and Sirmans (2008) study trading activity associated with the introduction of REIT-ETFs on the volatility of component REITs. They find volatility, for the component REITs, become more significant and positive related to changes in volatility for the S&P 500, after introduction of ETFs. Li (2011) develops a model of trading in dual markets, predicting more real estate trading in the public market than private market due to lower transaction costs. The incentive to trade public real estate is stronger in down markets due to increased illiquidity costs in private market.

As the world's largest asset class, real estate has asset value of U.S. $50 trillion, compared to U.S. $30 trillion for private equity. Commercial real estate is also attractive investment vehicel for retail and institutional investors. Within the last decade, the increase of capital flows into the real estate sector, the growth in variety and number of investment vehicles, and the increasing recognition among institutional investors of the potential for return enhancement a diversification from real estate within a multi-asset portfolio have contributed to the worldwide expansion of real estate capital flows and market development. Given the importantance of real estate in the overall economy and multi-assets portfolio, and a limited number of studies focusing on the nature and causes of changes in variance of REIT returns over time, the primary objective of this research is to study what determines REIT return volatility. In particular, it relates change in REIT stock volatility to a variety of time varying economic and market variables: market risk, firm level economic activities, financial leverage, inflation shocks and trading activities.

The Capital Asset Pricing Model (CAPM) breaks down total expected stock return or equity cost of capital into components relating to systematic market risk (beta) and unsystematic business/real estate sector specific risk. Extending CAPM, stock return volatility is decomposed into components related to systematic and unsystematic risks, providing the capability to focus on impacts of risk from different sources. Empirical findings, from a pooled sample of REITs from 1995 to 2009, show firms with higher beta, or when the stock market is more volatile, REIT volatility is also higher. This impact is magnified in up markets than in down markets, motivating research to study other risk factors that contribute to REIT stock return volatility when the housing market does not perform.

The Present Value Model (PVM) of Campbell (1987 and 1991) decomposes the variance of a stock into two parts: cash flow risk (changes in expected future dividends) and discount risk (changes in expected future returns). Variables of economic activities are used to proxy the impacts of cash flow risk and discount risk on REIT return volatility. The results suggest that news about future return measure by Return on Average Equity (ROAE) and news about cash flow measured by Dividend Yield (DY) negatively affects volatility in up markets. This is consistent with previous findings showing dividend and earnings information helps predict stock market returns for time horizons as far as five years (Fama and French, 1988b). High dividend yields and earnings signal quality firms, featuring less return fluctuations over time. The explanatory power of financial information is low in down markets, suggesting the potential impact of other factors on return volatility.

From Modigliani-Miller (M&M), equity REIT volatility is expressed as a combination of Debt-to-Equity (D/E) ratio, debt price volatility, and volatility of the firm's total value. This establishes a direct link between financial leverage and firm's equity return volatility. Empirical results support the theorem, showing REITs with high have high return volatility. The impact of leverage is magnified in down markets. In down markets, REITs with more volatile equity prices are more likely to reach the upper boundary for default, becoming financially distressed. Loan type (bond duration) matters, where volatility increases with short-term debt use, which could be attributed to the rollover risk of short-term debt (Gopalan (2010)).

There is a positive correlation between inflation shocks (both positive and negative) with REIT return volatility; suggesting any unexpected change in actual inflation drives up REIT return volatility. Interestingly, an unexpected drop in inflation has larger impact on REIT return volatility than an unexpected jump in inflation. Results from subsamples find the magnitude of inflation shocks is larger in down markets and for property types with short-term duration lease.

The last section of this research studies the link between trading activities and REIT return volatility. There is a positive price-volume relation documented in a variety of financial markets (Karpoff (1987)). Li (2011) develops a model of trading activities and return dynamics in dual markets. According to Li (2011), REIT trading occurs with higher frequency than in private real estate due to lower transaction costs of public trading. The gap in public-private trading is larger when markets distressed and smaller when markets are recovering (liquidity effect). Because high sale discounts and transaction costs related to private real estate is widely observed, especially in down markets. Comparison of returns for National Council of Real Estate Investment Fiduciaries (NCREIF) Property Index (NPI) and SNL REIT Equity index shows more volatility for private real estate returns, especially during the housing and financial crisis. Trading volume positively affects REIT return volatility, consistent with findings in common stock market by Schwert (1989) and Karpoff (1987). ETF component REITs have lower return volatility than non-index REITs before 2004 and higher after. Since ETFs indexes were made up of larger and better quality REIT firms, their component firms have less price fluctuation than non-index REITs in good times. After 2004, as ETF becomes popular and expanded as investment form, real estate investors started trading more through REITs, particularly through ETFs, increasing and contributing significantly to higher volatility for indexed REITs.

This research is organized as follows: Section 2, describes time series properties of data and strategy for modeling time-varying REIT return volatility; Section 3, analyzes relations of systematic and unsystematic risk with REIT return volatility; Section 4, studies the relationship between firm level economic activities and REIT return volatility; Section 5, analyzes the relationship between firm leverage and REIT return volatility; Section 6, studies the impact of inflation shocks on REIT return volatility; Section 7, focuses on the impact of trading on REIT return volatility; and Section 8, concludes the paper.

2 REIT Return Time Series Behavior

2.1 Data

The data for this research comes from the following sources. The daily return of U.S. Equity REIT stocks from January 1995 to December 2009 is obtained from CRSP daily stock files. The daily risk free rate and daily value-weighted NYSE/AMX market portfolio return is from Wharton Research Data Services (WRDS), which converts one month Treasury bill rate into one day return for CAPM calculation. Firm's quarterly financial data, such as Debt-to-Equity ratio (D/E), Net Asset Value (NAV), and Dividend Yield (DY) and Return on Average Equity ($ROAE$), are from SNL, which includes detailed Generally Accepted Accounting Principles (GAAP) financial information for all public REITs in the U.S. SNL also provides daily S&P 500 small firm price index and daily SNL Equity REIT index, representing common stock market and REIT market. Information for the top REIT ETFs constituents is provided by the related ETFs. Consumer Price Index (CPI) is from the Bureau of Labor Statistics (BLS), proxying the inflation rate. The final sample consists of 7,743 panel observations for economic activities analysis and 10,228 observations for leverage effects. There are 180 monthly observations for inflation shocks, which is tested by subsamples with different market conditions and property types.

Given the limited number of periods and limited number of firms by the data, the statistically reliable means of exploring relations between REIT return volatility and other factors is to rely on pooled data; because there is considerable heterogeneity in returns and firm characteristics. Tests based on pooled regressions are likely to have higher predictive power than tests based on time-series regressions, where predictive variables have only modest variance (Torous and Valkanov(2001)).

2.2 REIT Stock Return Volatility over Time

Following French, Schwert, and Stambaugh (1987), I use standard deviation to measure volatility of REIT returns. Quarterly standard deviations of daily return is calculated as the square root of sum of the squared daily returns (after subtracting the average daily return in the quarter):

$$\hat{\sigma}_{i,T} = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}(R_{i,t} - \bar{R}_i)^2} \tag{1}$$

where T is the number of days in a quarter, $R_{i,t}$ is return of stock i at date t in the quarter[1], $\bar{R}_i$ is the average return for stock i in the quarter. A rolling window is used to calculate the quarterly standard deviation of stock daily return, using the current

[1]The return measures the percentage change in stock value over a period of time and takes into account the effects of splits and other capital actions. Splits and dividends are relatively infrequent events, so the return for most days is simply the relative or percentage change in price from the end of one day to the end of the next.

day's return and the previous 66 trading day returns to obtain the quarterly standard deviation for that day.

Figure 1 compares the standard deviation of returns for the SNL-U.S. Equity REIT index and S&P 500 small firm index. The SNL-U.S. Equity REIT index covers all publicly-traded equity REITs in the SNL universe. It is a value-weighted index based on the market capitalization of the REIT firms, including 126 equity REITs for 2009. To be comparable to the small capitalization of REIT firms, this research uses the S&P 500 small cap index to represent common stock market. Results shown in figure 1 is REIT return volatility is lower than common stock volatility prior to 2004. After 2004, REIT return volatility increases over time and exceeds common stock volatility. The gap between REIT and common stock volatility jumps significantly during the housing crisis, where REIT return volatility is almost twice as common stock volatility in 2008. To capture change in market conditions, real estate up- and down-periods are identified according to the performance of the SNL-U.S. Equity REIT Index. Figure 2 exhibits, January 1998 to January 2000 and February 2007 to March 2009 as down-markets with declining index values, and the rest as up-markets. This specification identifies asymmetric impacts of various factors when market conditions vary.

3 REIT Stock Return Volatility and Market Risk

In the past twenty years, real estate has become increasingly integrated into the broader captial market, and widely accepted as legitimate asset class. So that its value now becomes more exposed to changes in allocations among investors, driven not by real estate fundamentals but by portfolio adjustments from other markets. For instance, the denominator effect, that caused many investors to reduce exposure to real estate in 2007, was driven by losses in the equity markets. Individual property values now depend more on broader capital market trends than they used to, relative to local property market conditions.

Basic finance theory breaks risk faced by investors into two sources: (1) systematic risk, due to risk factors affecting the overall market, and therefore, all properties are affected in a common manner (sometimes referred to as market risk, or beta risk); and (2) non-systematic risk, due to factors affecting only a particular property sector or location (sometimes referred to as idiosyncratic risk or diversifiable risk).

According to CAPM, the excess return of a stock i at time t could be written in the following form:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_{i,t} * (R_{m,t} - R_{f,t}) + \varepsilon_{i,t} \tag{2}$$

Where $R_{m,t}$ is the market return at time t, $R_{f,t}$ is the risk free rate at time t. $\beta_{i,t}$ measures the systematic risk of individual stock i at time t[2]. α_i represents the constant security return in excess of the risk free rate.

Derivation of the variance of excess return over a time interval T from (2) gives the following expression:

$$Var(R_{i,t} - R_{f,t})_T = \beta_{i,T}^2 Var(R_{m,t} - R_{f,t})_T + Var(\varepsilon_{i,t})_T + 2Cov(\beta_{i,T}(R_{m,t} - R_{f,t}), \varepsilon_{i,t})$$

where t is point of time in the interval T.

Since the covariance term between excess market return and error term is zero, as well as the correlation between excess market return and risk free rate, the above equation could be simplified as

[2] Each stock is assumed to have a time-varying systematic risk parameter $\beta_{i,t}$, which is a plausible assumption as a firm's risk characteristics change over time.

$$Var(R_{i,t})_T = \beta_{i,T}^2 Var(R_{m,t} - R_{f,t})_T + Var(R_{f,t})_T + Var(\varepsilon_{i,t})_T$$

That is

$$Var(R_{i,t})_T = \beta_{i,T}^2 Var(R_{m,t})_T + (1 + \beta_{i,T}^2) Var(R_{f,t})_T + Var(\varepsilon_{i,t})_T \quad (3)$$

This equation decomposes REIT return variance into two parts: the first two items measure contribution of systematic risk, while the third measures contribution of unsystematic risk.

This research uses the value-weighted NYSE/AMEX portfolio daily return to proxy for $R_{m,t}$ and daily one-month treasury bill rate for $R_{f,t}$. REIT annual betas are derived using the method of Scholes and Williams (1977)[3]. Figure 4 is the Box and Whisker Plot analysis of REIT betas distribution over time. The median value increases over time, indicating that real estate properties become more exposed to common fundamental factors of the capital markets. Over the past 20 years, the fastest growth in integration between real estate and capital markets has ocurred. During this period, the importance of beta-risk in the real estate market has grown significantly. Thus, beta-risk is an increasingly important part of overall value risk of property investment decisions. The distribution of REIT betas have become flatter, and shows increasing variation in recent periods.

The following structured model is used to test 3,

$$\hat{\sigma}_{i,T}^2 = a_1 + a_2 \hat{\beta}_{i,T}^2 \hat{\sigma}_{m,T}^2 + a_3 (1 + \hat{\beta}_{i,T}^2) \hat{\sigma}_{R_f,T}^2 + a_4 \hat{\sigma}_{\varepsilon_i,T}^2 + u \quad (4)$$

where

$\hat{\sigma}_{R_m,T} = \sqrt{\frac{1}{T-1} \sum_{t=1}^{T} (R_{m,t} - \bar{R}_m)^2}$

[3] The specific methodology of Scholes and Williams(1977) is described in Appendix A.

$$\hat{\sigma}_{R_f,T} = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}(R_{f,t} - \bar{R}_f)^2}$$
$$\hat{\sigma}_{\varepsilon_i,T} = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}(\varepsilon_{i,t} - \bar{\varepsilon}_i)^2}$$

a_2 and a_3 measure the impact of systematic risk. a_4 measures the impact of unsystematic risk. Consistent with the above equation, the dependant variable is the firm's quarterly variance. $\varepsilon_{i,t}$ and $\hat{\beta}_{i,T}$ are obtained from a first stage CAPM regression of (2).

In Table 1, two things about market risks in determining REIT return volatility are apparent from the results. First, the sensitivity of REIT return volatility to unsystematic risk is quite persistent across different market conditions. The coefficient is significant at 1.01 for both up- and down-markets, suggesting a one-by-one change in the variance of unsystematic risk component and the variance of REIT return. Second, there are two aspects of systematic risk from the estimation. For firms with higher betas or when the common stock market is more volatile, REIT return volatility is higher. The coefficient is 1.22 in up markets, higher than 0.79 in down markets. The cyclical finding indicates that REITs become more "like" each other in up markets than during down markets; and REIT returns are less correlated with overall capital markets in bad market conditions. Diversification between REITs and common stocks therefore tends to become more effective during downs markets, presumably when investors would most value it. The other aspect of systematic risk is from changes in the risk-free rate, that is negative and significant. Since the risk-free rate change is incremental over time, the impact is negligible compared to the other two sources of risk.

4 REIT Stock Return Volatility and Economic Activities

The present value model of Campbell (1987 and 1991) decomposes the variance of a stock into two parts: cash flow risk (changes in expected future dividends) and discount risk (changes in expected future returns). Log real return to stock at time $t+1$ could be written in the following form:

$$r_{t+1} = log(P_{t+1} + D_{t+1}) - logP_t$$

From this relationship, Campbell (1987) breaks down news about future excess stock return into two components: news about cash flow (cash flow risk) and news about future return (discount rate risk). The fundamental equation is:

$$r_{t+1} - E_t r_{t+1} = (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^{j-1} \triangle d_{t+j} - (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^{j} r_{t+1+j} \qquad (5)$$

Where E_t is the expectation formed at the end of period t, r_{t+1} is the log of real return on asset held from the end of period t to the end of period $t+1$, d_{t+1} is the log of the real dividend paid during period $t+1$, $\triangle$ is a one period backward difference, and $(E_{t+1} - E_t)$ represents a revision in expectations given the new information arrival at time $t+1$. The parameter ρ is a constant and is the average ratio of stock price to the sum of stock price and dividend. The intuition of the above equation is that if the unexpected return on an asset is negative, given internally consistent expectations, then either the expected future growth in cash flows (dividends) must decrease, the expected future returns (discount rate) on an asset must increase or both. Findings for U.S. stock market data suggest that one-third of the variance of unexpected stock return is attributed to the variance in changing expected dividends, one-third to the variance in changing expected future return, and one-third to the covariance of the two. Liu and Mei (1994) use this present value model to decompose real estate risk. The authors find cash-flow news plays a significant role in explaining predictability of REIT returns, which is attributed to the fact that dividend is a significant component of REIT returns, due to strict payout policy. They document that discount rate news is also an important component of return fluctuations.

Since new information causes time-varying expected return, it may predict time-varying volatility. Consistent with previous studies, I use financial information to proxy news about future excess stock return. Dividend Yield (DY) serves as proxy for cash flow information, and Return on Average Equity ($ROAE$) and Net Asset Value (NAV) for future expected return information are used as profit ratios and are likely to affect future expected returns. Different from previous studies, I include NAV in REIT return volatility estimations. NAV is one of the most important valuation indices of REITs, normally quoted on a "per investment unit" basis, where the value is divided by the number of total outstanding investment units (shares). In simple terms, NAV is an adjusted net asset value, reflecting the market value of real estate properties held by an investment corporation. It is synonymous to the adjusted price-to-book ratio applied to stocks in which factors such as unrealized losses/gains of owned properties and brand values are reflected. The lag values of financial variables are used in estimating of REIT return volatility, with the following structured model:

$$\hat{\sigma}_{i,t} = a_1 + a_2 DY_{i,t-1} + a_3 ROAE_{i,t-1} + a_4 NAV_{i,t-1} + \varepsilon_i$$

Table 2 shows both DY and $ROAE$ negatively affect REIT return volatility in up markets. When there is a 1% increase in DY, the quarterly standard deviation of REIT returns decrease by 0.027%. Every 1% increase in $ROAE$ leads to a 0.0049% decrease in REIT return standard deviation. Higher dividend yield and earnings information signal good quality firms, they have less price fluctuations than othe firms due to healthy performance and stable growth. Since REITs are known for high dividend payout ratios, the impact of DY on return volatility is larger than $ROAE$. In down markets, economic activities have less explanatory power, suggesting that other potential channels of influences are contributing to high REIT return volatility in down markets.

5 REIT Stock Return Volatility and Firm Leverage

One explanation for time-varying stock return volatility is that the impact of financial leverage changes as relative stock and bond prices change. From Modigliani-Miller (M&M), the volatility of a firm's value can be written as followed:

$$\sigma_{vt}^2 = (\frac{E}{V})_{t-1}^2 \sigma_{Et}^2 + (\frac{D}{V})_{t-1}^2 \sigma_{Dt}^2 + 2(\frac{E}{V})_{t-1}(\frac{D}{V})_{t-1} cov(R_{Et}, R_{Dt})$$

Where σ_{vt}^2 is the volatility of a firm's value, $\frac{E}{V}$ is the equity to value ratio, $\frac{D}{V}$ is the debt-to-value ratio, σ_{Et}^2 is the volatility of the firm's equity and ${\sigma_{Dt}}^2$ is the volatility of the firm's debt.

Consider a firm with constant interest rate, no dividends, and with a single class of riskless debt. Further assume that volatility of a firm's value is constant. Then, the standard deviation of equity returns can be shown as,

$$\sigma_{Et} = \sigma_{vt}(\frac{V}{E})_{t-1} = \sigma_{vt}(1 + \frac{D}{E})_{t-1}$$

Where σ_{Et} denotes the standard deviation of the equity value, $\frac{D}{E}$ is the market leverage ratio, andσ_{vt} is the standard deviation of firm value. In this scenario, the volatility of equity values is an increasing function of financial leverage.

If price data for corporate debt were readily available, the market value of debt-to-equity could be used for testing. Since this is not the case, it is necessary to use the face value of debt in constructing the leverage ratio. This research uses the contemporaneous debt-to-equity ratio to measure the leverage level of the firm. In down markets, when stock prices drop, the firm's $\frac{D}{E}$ ratio increases. The return volatility is also expected to increase as the firm becomes more leveraged.

To look at the potential impact of loan types, I include lag ratio of short-term debt-to-total debt (SD/D) in the regression. The estimation structure model is as following:

$$\hat{\sigma}_{i,t} = a_1 + a_2(\frac{SD}{D})_{i,t-1} + a_3(\frac{D}{E})_{i,t-1} + \varepsilon_i$$

Results in Table 3 supports the prediction from extended M&M theory. Firm leverage positively affects REIT return volatility, similar to findings for common stock market by Schwert (1989). The impact is almost tripled in down markets compared to in up markets. It could be due to the fact that at down market, financial distress increases the magnitude of leverage effect. According to the Merton (1974) model, corporate debt is a risk-free bond less a put option on the value of the firm's assets, where strike price is the face value of the debt. Thus, a firm with more volatile equity is more likely to reach the boundary condition for default and become financial distressed. Firms with historical high leverage are more likely to become financially distressed than those starts with a lower leverage ratio.

The return volatility also increases with the use of short-term debt, due to the fact short-maturity debt exposes the firm to rollover risk, which increases the firm's overall credit risk (Gopalan 2010). An emerging theoretical literature argues that the rollover risk emanating from a firm's reliance on short-term debt increases the firm's overall credit risk, because rollover risk makes the firm susceptible to a run by its creditors (Morris and Shin(2009), He and Xiong(2010b)) and diminishes its debt capacity (Acharya et al. (2010)). Gopalan (2010) finds that all else equal, firms with a higher proportion of their debt maturing within the year are more likely to experience deterioration in their credit quality. If these theoretical predictions are correct, then firms with greater exposure to rollover risk should, all else equal, face a higher cost of debt, be more susceptible to a deterioration in their credit quality and have a more volatile stock performance, consistent with findings in Table 4. The impact of short-term debt is larger in up markets than in down markets.

6 REIT Stock Return Volatility and Inflation Shock

Higher inflation affects equity returns in two ways. First, it leads to a weaker economy and reduced corporate profits. Second, an increase in inflation increases the riskiness of financial and real assets and thus increases the required rate of return demanded by investors. Investors seek ways to diversify equity risk, which has historically dominated their portfolio decisions, while also finding ways to guard against real declines in purchasing power posing a significant long-term risk. The following REIT attributes make an effective hedge against inflation risk possible. First, REIT returns offset changes in CPI due to rent increases and adjustments. In economic environments where lease rates are increasing over time, reflecting real estate inflation, REITs generate higher income, driving the price of REITs higher. Most property sectors, such as retail and office, are characterized by multi-year lease contracts, in which rents are adjusted upward automatically to compensate for an increase in the CPI. Other sectors of the commercial real estate utilizing short-term lease terms, such as multifamily, can impose rental increases in times of high demand to keep up with inflation pressures as their shorter leases expire. Hotel REIT can implement price increases in the face of rising demand on a daily basis. Second, in times of rising inflation, many investors move reallocate cashflows into real assets, such as real estate. REITs are real estate in a securitized form, which provides an easier inflation hedged tool than direct commercial real estate investment, in terms of both liquidity and capital constraints.

The impact of inflation shocks is tested, as it is new information that triggers increases in investment activities. Inflation persistence over time is commonly observed in U.S. and other countries. The most common measures of inflation persistence, suggested in the literature, is in the context of univariate time-series representation. Under the univariate approach, persistence is investigated by looking at the univariate time series representation of inflation. It is customary in the literature to assume that inflation follows a stationary autoregressive process of order 1, as written in equation6. The error term in the AR(1) regression captures the unexpected component of inflation, defined as inflation shock.

$$\pi_t = a_1 + \pi_{t-1} + \varepsilon_t \tag{6}$$

The estimation of expected inflation $\hat{\pi}_t$ and inflation shock $\hat{\varepsilon}_t$ are obtained from equation6. Monthly standard deviation of SNL U.S. Equity REIT index daily return is estimated for REIT volatility to match monthly CPI. The asymmetric effects of positive and negative inflation shocks is tested with the following structure model:

$$\hat{\sigma}_t = b_1 + b_2\hat{\pi}_t + b_3\hat{\varepsilon}_t + b_4\hat{\varepsilon}_t * Dum + u_t$$

Dum is a dummy variable, which equals to one for a positive shock (inflation above expected levels), and zero for a negative shock (inflation below expected levels). The crossterm of the indicator and an unexpected inflation series is also created. Therefore, the coefficient associated with the unexpected inflation series represents the marginal impact of a negative inflation shock on volatility, while the marginal effect of a positive shock can be estimated by adding the coefficients associated with the unexpected series and the crossterm. To take account of property type, the tests include subsample REIT index data for hotel, industrial, multifamily, office and retail sectors.

Figure 3 exhibits significant fluctuations in monthly U.S. CPI in our sample period. Table 5 shows significant asymmetries for both unexpected inflation variables, though the nature differs. The coefficients associated with unexpected inflation shocks are uniformly negative and significant. This suggests that, ceteris paribus, an unanticipated reduction in inflation is associated with higher REIT return volatility. Further, coefficients associated with the crossterms are positive, and larger in magnitude, than corresponding coefficients of unexpected inflation. Therefore, the sum of the two, which measures the effect of an unanticipated increase in inflation, is positive and significant. This indicates that an unanticipated increase in inflation is also associated with high REIT return volatility. Regardless of the sign of the inflation shock, unexpected inflation always increase REIT return volatility. By comparing results in different subperiods, the research also shows one unit of inflation shock leads to higher REIT return volatility in down markets than in up markets, and holds across REIT sectors with different property types. This is consistent with trading theory in down markets, REITs are more likely to be traded for portfolio adjustment purposes (Li(2011)). Another finding is that the impact of inflation shocks on REIT return volatility is higher for property sectors using shorter lease term, such as hotel and industrial. This is because return volatility in properties that use short-term leases are more responsive to changes in inflation and interest rate.

7 REIT Stock Return Volatility and Trading Activities

When considering portfolio allocation of investment to real estate, investors can make decisions ranging from building size, location, risk strategy; but ultimately all real estate investments are one of the two types: public or private. The allocation of trading between public and private markets affects return dynamics. Li (2011) studies trading activities in a dual market system and predicts that real estate investors place more orders for REITs to take advantage of lower transaction costs. This incentive is stronger in down markets because of significantly increased illiquidity in private real estate market. The increased trading activities in REIT markets result in higher REIT return volatility at down markets. This section focuses on the impact of trading activities on

REIT return volatility.

7.1 REIT Return Volatility and Trading Volume

Karpoff (1987) cites 18 separate studies that document positive price-volume relationships in a variety of financial markets. He argues that price changes reflect market evaluation of new information, while volume is an indicator of the degree to which investors disagree with the meaning of information. Different interpretations of new information force various responses to new information, which leads to price changes in the market. Li (2011) establishes a price mechanism where trading induces change in asset prices. To estimate the impact of trading volume on REIT stock return volatility, the following equation is estimated,

$$\hat{\sigma}_{i,t} = a_1 + a_2 * Vol_{i,t} + u_t$$

where $Vol_{i,t}$ is the average daily trading volume for stock i at month t and $\hat{\sigma}_{i,t}$ is the monthly stock return standard deviation of stock i at month t calculated by the method described in Section 2.

Table 6 reports the estimates for volume-volatility relation in various market conditions. The results exhibit a positive impact of trading volume on REIT return volatility, consistent with previous literature. The magnitude is larger in down markets than in up markets. Because in thin market, the market depth paramter, which measures impact of volume on price, is larger due to higher transaction costs, consistent with theory prediction in Li (2011).

7.2 REIT Return Volatility and ETF Trading

High payout ratios and the belief that REITs will not move step-by-step with the stock market makes REIT allocations an important portfolio diversification tool. For stock market investors, there is a toolto tap in to that growth through the use of REIT ETFs. REIT ETFs are Exchange-Traded Funds that invest the majority of assets in equity REIT securities and related derivatives. ETFs are passively managed around an index of publicly-traded real estate companies. Indexes may vary from provider to provider, but two of the most popular benchmarks are the Morgan Stanley Capital International (MSCI) U.S. REIT Index and the Dow Jones U.S. REIT Index. Both indicies cover two-thirds of the aggregate value of the publicly-traded REIT market domestically.

Lu, Wang, and Zhang (2009) document the extent of rebalancing necessary at the end of each day (or early in the next day) for the funds to achieve their desired exposure to track the benchmark. This kind of rebalancing could has a major impact on exacerbating volatility, because these funds have significant assets under management and have to rebalance in the same direction at day's end, increasing the stock return volatility. ETF component stocks are expected to experience higher volatility than off-index stocks. Boney and Sirmans (2008) study trading activity associated with the introduction of REIT ETFs on the volatility of component REITs. They finds volatility for the component REITs becomes more significant and positive related to changes in volatility for the S&P 500 after the introduction of ETFs.

The top 3 REIT ETFs in the U.S are Vanguard's REIT ETF (VNQ), iShares' Dow Jones U.S. Real Estate Index Fund (IYR), and State Street's DJ Wilshire REIT ETF (RWR)[4]. Table 7 exhibits the top 10 REIT firms in the three ETFs and their weights

[4]VNQ has value of $2.3 billion U.S. dollars and tracks the MSCI US REIT Index. The index consists of 96 REITs spread across the retail, residential, office, industrial and specialized sectors. IYR has value of $1.9 billion U.S. dollars and tracks the Dow Jones U.S. Real Estate Index, which holds 77 REITs and is similar in composition to the Morgan Stanley Index. RWR is $1.3 billion U.S. dollars and tracks 87 REITs.

in terms of market values in each ETF. The major component firms of the three ETFs are similar.

To test whether index feature matters to return volatility, an index dummy is constructed as 1 for index REITs in table 7 and 0 otherwise. After 2004, ETFs become a more popular and expanding trading form. To capture the time effect, the year dummy equals 1 if it is after 2004, 0 otherwise. To examine the incremental effect of index introduction, the cross term of year dummy and index dummy is included in the following structure model:

$$\hat{\sigma}_{i,t} = a_1 + a_2 * I_{(index)} + a_3 * I_{(t \geq 2004)} + a_4 * I_{(index, t \geq 2004)} + u_t$$

Table 8 reports the estimation results for the above equation. Results show a significant negative coefficient for the index dummy, indicating that the indexed REITs have on average 0.005 lower return volatility than non-indexed REITs before 2004. The positive sum of coefficients of cross term and index dummy, with a significant F value, suggests index REITs have higher volatility than non-index REITs after 2004. Index REITs are usually large and good quality firms, which enjoy stable performance and lower price fluctuations in normal time. After 2004, when investor REIT trading increasely went through the more popular ETF tool, the results show high trading volume contributes to higher return volatility for index REITs. The positive and significant coefficient of year dummy suggests that after 2004, REIT return volatility increased, consistent with more REIT trading in down markets.

Table 9 reports the results of pooling regression with economic activities, leverage and ETF trading. Future return news as$ROAE$ affects REIT return volatility negatively, controlling other variables. The leverage effect is only significant in up markets, suggesting that other sources of risk affect REIT return volatility then in down markets. After 2004, REIT return volatility is signigicantly higher compared to before 2004, consistent with findings in Figure 1. The ETF dummy loses significance after controlling for other firm characteristics.

8 Conclusion

The U.S. REIT market has experienced significant stock return fluctuations in recent years, almost twice that of the common stock market. The dramatically increase in REIT return volatility during the recent housing crisis imposed adverse impact on individual REIT firm values as well as the whole commercial real estate industry. This research provides a comprehensive study on the determinants of REIT stock return volatility, taking into consideration market risks, economic activities, firm leverage, inflation shocks and trading activities.

Evidence shows an increasing integration of the REIT market with the common stock market over time. Systematic risk has a positive and significant impact on REIT return volatility in up markets. News about cashflow (DY) and future expected return ($ROAE$) both affect return volatility negatively. REIT return volatility increases with firm leverage, distress and use of short term debt. Higher inflation shocks are associated with higher REIT return volatility, with a larger impact in down markets, and in property types using short-term leases. Empirical tests on trading-volatility suggest a positive correlation between volume and volatility. Moreover, ETF index constituent firms have higher return volatility after 2004 when an increasing amount of REITs trading ocurred through ETFs.

The findings of this paper provide a deep understanding to academic and practitioners on the determinants of REIT return volatility. This knowledge of the underlying factors for REIT return volatility should help stockholders to make better portfolio investment and risk management decisions in the future.

References

[1] Acharya, V., D. Gale, and T. Yorulmazer (2010). Rollover risk and market freezes. Working Paper, New York University.

[2] Amihud, Y., and H. Mendelson (1991), Liquidity, Maturity and the Yield on U.S. Treasury Securities, Journal of Finance, 46,1411-1425

[3] A. Plazzi, W.Torous and R.Valkanov (2010), Expected Returns and Expected Growth in Rents of Commercial Real Estate, The Review of Financial Studies, Vol 23, issue9.

[4] Andy C.W. Chui, Sheridan Titman, and K.C. John Wei (2003), The cross-section of expected REIT returns, Real Estate Economics 31, 451-479

[5] Bajaj,M., D.J. Dennis, S.P.Ferris and A.Sarin (2001), Firm Value and Marketability Discounts, Journal of Corporate Law, 27

[6] Bekaert, Geert and Wu, Guojun (2000), Asymmetric Volatility and Risk in Equity Markets, Review of Financial Studies, vol. 13(1), pages 1-42.

[7] Black F. 1976, Studies of stock price volatility changes, proceeding of the 1976 meetings of American Statistical Association, Business and Economic Statistics Section, 177-181

[8] Case, Karl E., John M. Quigley, and Robert J. Shiller (2003), Homebuyers, Housing and the Macroeconomy, in Anthony Richards and Tim Robinson Eds.: Asset Prices and Monetary Policy (Canberra: Reserve Bank of Australia)

[9] Campbell, John Y (1987), Stock Returns and the Term Structure, Journal of Financial Economics, Vol18.

[10] Campbell, John Y (1991), A Variance Decomposition of Stock Returns, The H.G. Johnson Lecture to the Royal Economic Society, Economic Journal 101.

[11] Campbell, John Y and R.J. Shiller (1988), The Dividend-Price Ratio and the Expectations of the Future Dividends and Discount Factors, Review of Financial Studies, Vol1, 195-228

[12] Campbell, John Y, M.Lettau, B.G. Malkiel and Yexiao Xu (2001), Have Individual Stocks Become More volatile? An empirical Exploration of Idiosyncratic Risk. Journal of Finance, Vol LVI, No 1.

[13] Chen, Lesmond and Wei (2007), Corporate Yield Spreads and Bond Liquidity, Journal of Finance. Vol 61, No. 1

[14] Christie, A.A. (1982), The stochastic behavior of common stock variances, Journal of Financial Economics, 10, 407-432

[15] C.H.Liu and Jianping Mei (1994), An Analysis of Real-Estate Risk Using the Present Value Model, Journal of Real Estate Finance and Economics,Vol8.

[16] Cox,D.R. and D.R. Peterson (1994), Stock Returns Following Large One-day Declines: Evidence on Short-term Reversals and Long-term performance, Journal of Finance, 48, 255-267

[17] Dennis, P., S. Mayhew, and C.Stivers (2006), Stock returns, implied volatility innovations, and the asymmetric volatility phenomenon, Journal of Financial and Quantitative Analysis, 41,2

[18] Dumas, Bernard, and E. Luciano (1991), An Exact Solution to a Dynamic Portfolio Choice Problem under Transaction Costs, Journal of Finance, Vol46.

[19] Eleswarapu, V, and M. Reinganum (1993), The Seasonal Behavior of the Liquidity Premium in Asset Pricing, Journal of Financial Economics, 1993, 34, 281-305

[20] Engle, Robert F and Ng, Victor K (1993), Time-Varying Volatility and the Dynamic Behavior of the Term Structure, Journal of Money, Credit and Banking, vol. 25(3), pages 336-49

[21] E.F.Fama and K.R French(1988), Dividend Yields and Expected Stock Returns, Journal of Financial Economics,Vol22.

[22] E.F.Fama and G.W.Schwert (1977), Asset Returns And Inflation, Journal of Financial Economics, Vol5(2), 115-146

[23] E.F.Fama, G.W.Schwert and R.Stambaugh (1987), Expected Stock Returns and Volatility, Journal of Financial Economics, Vol19, 3-29

[24] He, Z. and W. Xiong (2010b). Rollover risk and credit risk. Working Paper, Princeton University.

[25] Lingxiao, Li (2011), Trading and Volatility in Dual Markets, Working Paper

[26] J. Gopalan(2010), Debt Maturity Structure and Credit Quality, Working paper

[27] G.W.Schwert (1989), Why Does Stock Market Volatility Change Over Time? Journal of Finance, Vol XLIV, No6.

[28] Krainer, J., M. Spiegel, and N. Yamori (2004), Asset Price Declines and Real Estate Market Liquidity: Evidence from Japanese Land Values. Working Paper 2004-16, Federal Reserve Bank of San Francisco.

[29] Merton, Robert C., (19740, On the Pricing of Corporate Debt: The Risk Structure of Interest Rates, Journal of Finance, Vol 29, 449-470.

[30] Morris, S. and H. S. Shin (2009). Illiquidity component of credit risk. Working Paper, Princeton University.

[31] M. Scholes and J. Williams (1977), Estimating Betas from Nonsynchronous Data, Journal of Financial Economics, Vol 5, 309-327.

[32] Pastor, Lubos and Stambaugh, Robert F (2005), Liquidity Risk and Expect Stock Returns. Journal of Political Economy, Vol. 111.

[33] Roll, Richard (1988), R^2, Journal of Finance, Vol 43, 541-566.

[34] Stephen F. LeRoy and Richard D. Porter (1981), The Present Value Relation: Tests Based on Implied Variance Bounds, Econometrica, Vol 49,555-574.

[35] Torous, Walter N, and Rossen Valkanov (2001), Boundaries of Predictability: Noisy Predictive Regressions, UCLA Working paper.

[36] Wu.G. and Z. Xiao (2002), A Generalized Partially Liner Model of Asymmetric Volatility, Journal of Empirical Finance, 9, 287-319

A Scholes-Williams Beta Calculation

Beta is a statistical measurement of the relationship between two time series, and has been used to compare security data with benchmark data to measure risk in financial data analysis. CRSP provides annual betas computed using the methods developed by Scholes and Williams (1977).

Beta is calculated each year as follows:

$ret_{i,t}$ =log (1 + return for security$i$ on day t)

$mret_{i,t}$ = log (1 + value-weighted market return on day t)

$mret3_t = mret_{t-1} + mret_t + mret_{t+1}$(a 3 days moving average market window)

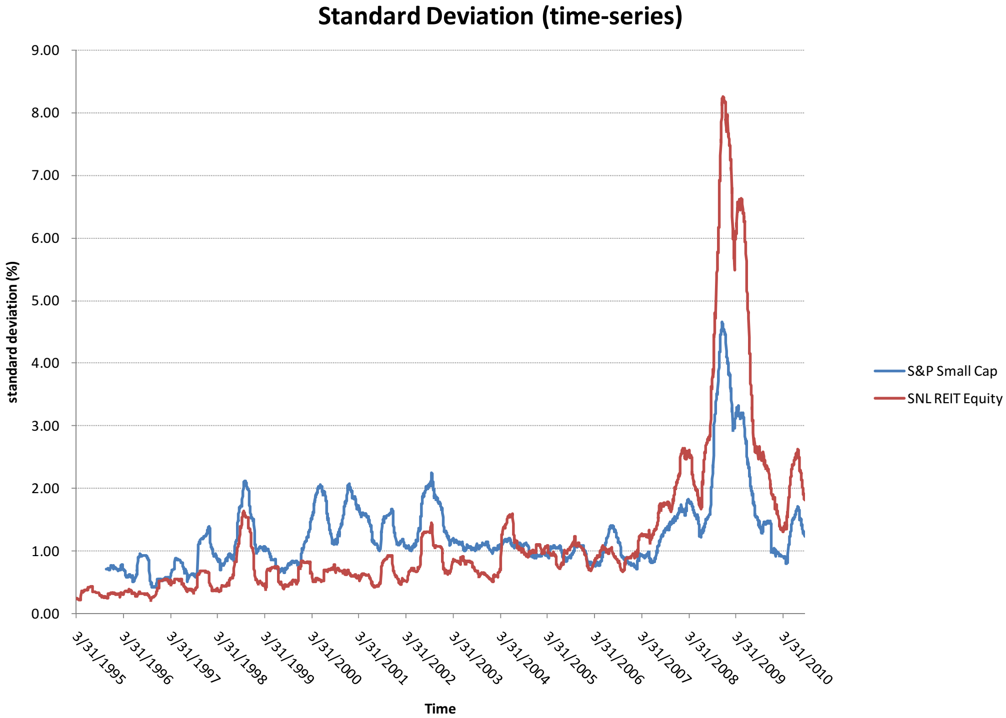
n= number of observations for the year

$$\beta_i = \frac{\sum_t (ret_{i,t} * mret3_t) - \frac{1}{n}(\sum_t ret_{i,t})(\sum_t mret3_t)}{\sum_t (mret_t * mret3_t) - \frac{1}{n}(\sum_t mret_t)(\sum_t mret3_t)}$$

where summations over t are over all days on which security i traded, beginning with the first trading day of the year and ending with the last trading day of the year.

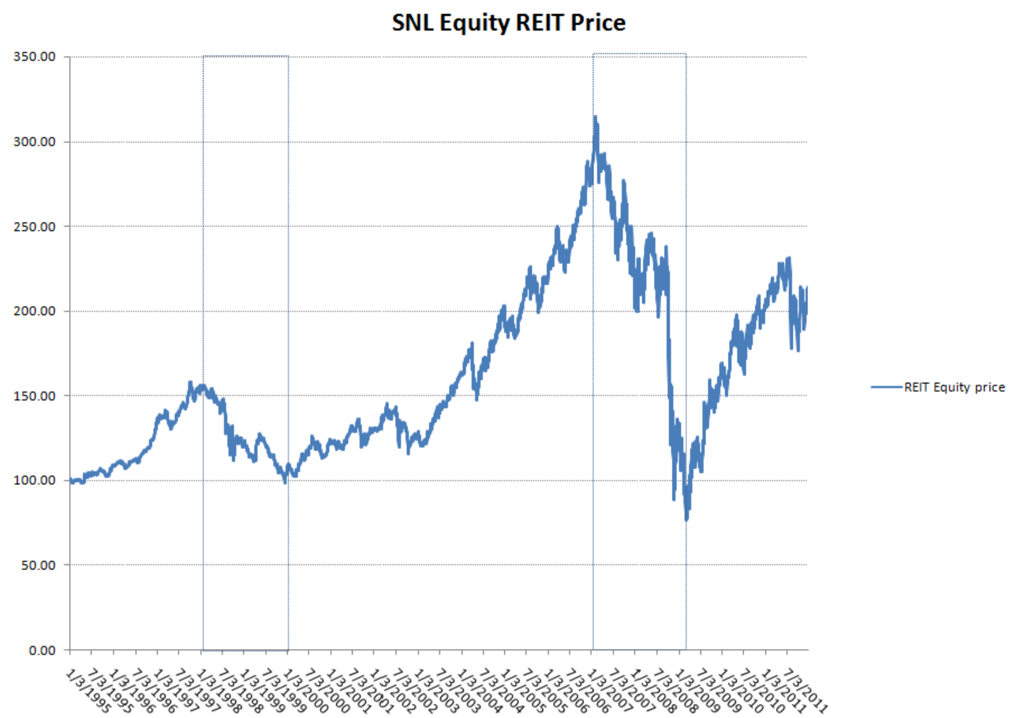
Based on Scholes-Williams Beta calculations, in the NYSE/Amex portfolios, only trading prices are considered in the beta calculation, and a security must have traded half the days in a year to be given a non-missing beta for that year. The index used in the calculation is the total returns on the Trade-only NYSE/Amex Value-Weighted Market Index.

Figure 1: Standard Deviation of REIT Stock Return and Common Stock Return



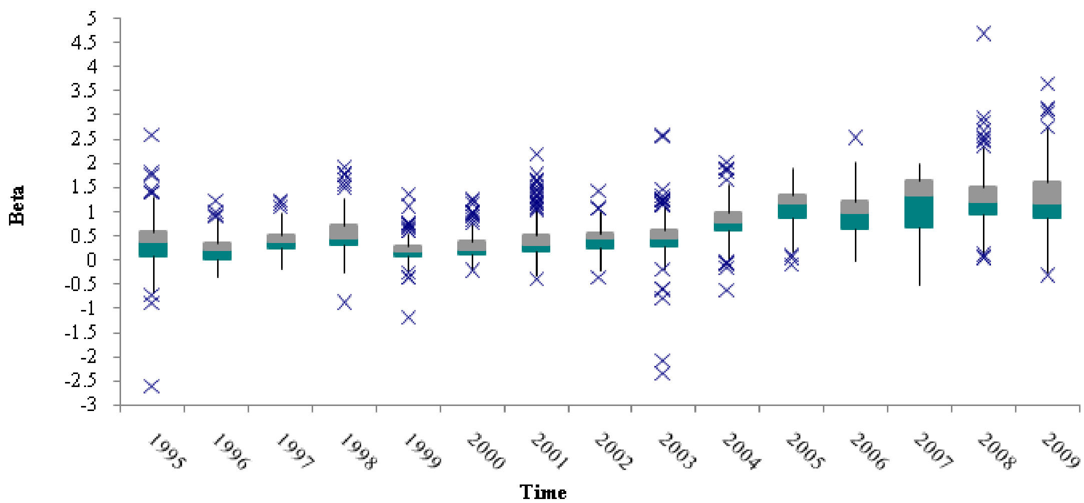
The figure shows the time series trend of standard deviation of REIT return and common stock return. The daily return for SNL U.S Equity REIT index is used to represent the REIT return. The daily return for S&P small cap index is used to represent the variation common stock return due to the similar size between these two groups. The rolling window is used to calculate the quarterly standard deviation for daily index return with the current return and the previous 66 trading days' returns. Daily index return is the percentage change on the index value on that day. The blue line is the quarterly standard deviation for S&P small cap index return. The red line is the quarterly standard deviation for US Equity REIT index return. The X-axis is time period from January 1995 to December 2009. The Y-axis is the standard deviation in percentage term. The S&P small index dates back to August 16,1995. It shows REIT return volatility increased dramatically in recent years, compared to the volatility of common stocks.

Figure 2: Price Performance of SNL Equity REIT Index



This Figure describes the performance of SNL Equity REIT index in the sample period. The X-axis is the time line from January 1995 to December 2009. The Y-axis is the price index value. The period in the dotted area is identified as down period according to the performance of the index value.

Figure 3: Distribution of Betas for REITs over Time



The x-axis is the time line from January 1995 to December 2009. The y-axis is the value of REITs' betas. The box represents the distance between the 1st and 3rd quartiles of REITs' betas at each point of time. The split in the box represents the median value of betas at each point of time. The up whiskers show the greater of max value or 1.5 times the box (Q3-Q1). The bottom whiskers show the lower of min value or 1.5 times the box (Q3-Q1). Outlier points on the top are those that are greater than 1.5 times (Q3 -Q1).

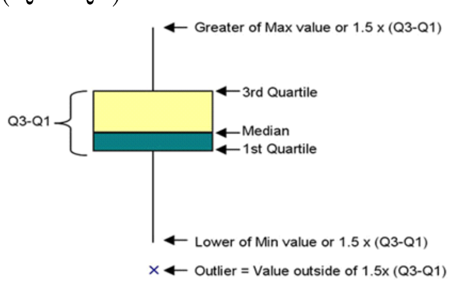
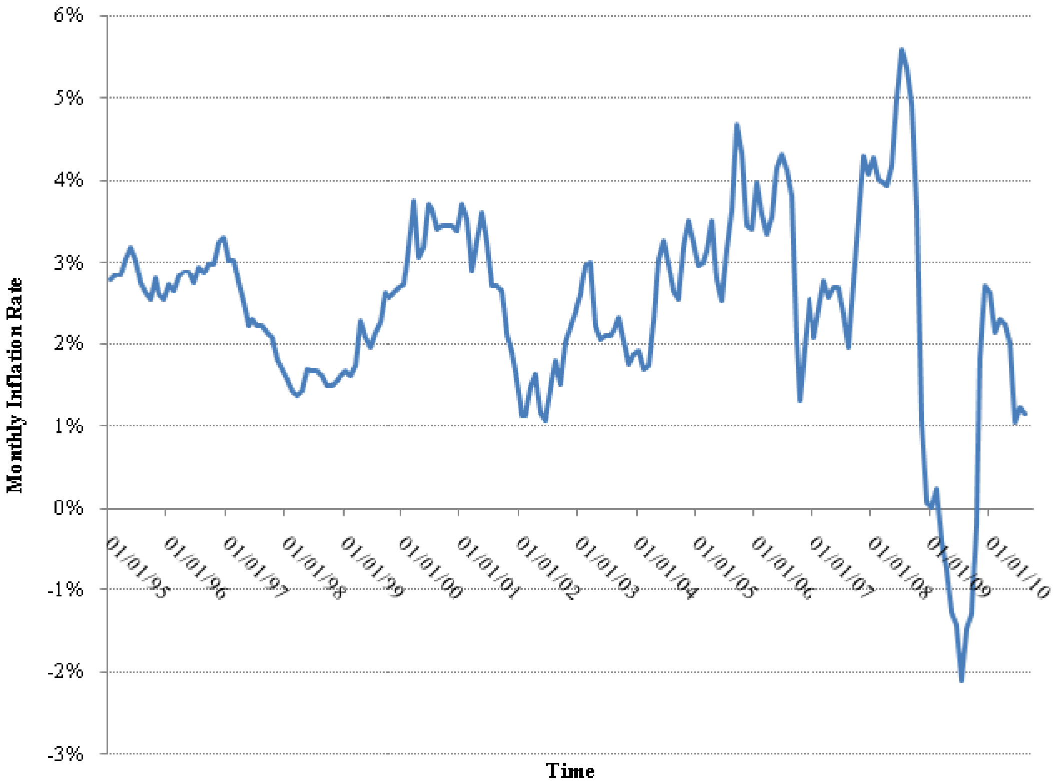


Figure 4: U.S. Monthly Inflation Rate



This figure shows the change in the U.S inflation rate change during our sample period.The blue line is the monthly inflation rate in U.S, which is the calculated as monthly change in the consumer price index (CPI) for U.S. The X-axis is time period from January 1995 to September 2010. The Y-axis is the inflation rate is percentage term. It shows a fluctuation in the U.S inflation rate over time.

Table 1: REIT Return Volatility and Market Risk

	$\hat{\beta}_{i,t}^2\hat{\sigma}_{R_m,T}^2$	$(1+\hat{\beta}_{i,t}^2)\hat{\sigma}_{R_f,T}^2$	$\hat{\sigma}_{\varepsilon_i,T}^2$	R^2	*obs*
Sample	0.89***	-2.09***	1.01***	0.96	10250
Up market	1.22***	-1.24***	1.01***	0.99	7446
Down Market	0.79***	-5.15***	1.01***	0.96	2804

The table presents coefficient estimates for REIT stock price volatility and market risk regression. $\hat{\beta}_{i,t}^2\hat{\sigma}_{R_m,T}^2$ is the systematic risk components from market return volatility. $(1+\hat{\beta}_{i,t}^2)\hat{\sigma}_{R_f,T}^2$ is the systematic risk components from risk free volatility, scaled down by 10^{-5}. $\hat{\sigma}_{\varepsilon_i,T}^2$ is the unsystematic risk components. Up market and down market is defined in Section 2 according to the performance of SNL U.S. Equity REIT index. ***,**,and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 2: REIT Return Volatility and Economic Activities

	$DY_{i,t-1}(10^{-1})$	$ROAE_{i,t-1}(10^{-2})$	$NAV_{i,t-1}(10^{-4})$	R^2	*obs*
Sample	-0.15	-0.56**	-0.006	0.03	7443
Up market	-0.27**	-0.49**	0.02	0.033	5037
Down market	-0.26	-0.6	-0.24	0.01	2406

The table presents coefficient estimates for REIT volatility and economic activities regression. The dependent variable is the quarterly stock return volatility for REIT i at quarter t. $\hat{\sigma}_{i,t-1}$ is the lagged REIT stock return volatility. $DY_{i,t-1}$ is the lagged dividend yield ratio for REIT i at quarter t, scaled by 10^{-1}. $ROAE_{i,t-1}$ are scaled by 10^{-2}. $NAV_{i,t-1}$is scaled by $10^{-4.}$ Up market and down market is defined in Section 2 according to the performance of SNL U.S. Equity REIT index. ***,**,and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 3: REIT ReturnVolatility and Firm Leverage

	$SD/D_{i,t-1}(10^{-3})$	$D/E_{i,t-1}(10^{-3})$	R^2	obs
Sample	7.2*	1.17**	0.13	4098
Up market	7.7*	0.68**	0.14	2611
Down market	4.6*	2.6***	0.11	1487

The table presents coefficient estimates for REIT volatility and economic activities regression. $D/E_{i,t-1}$ is the lag debt-to-equity ratio. $SD/D_{i,t-1}$ is the lag ratio of short term debt to total debt. Both are scaled by 10^{-3}. Up market and down market is defined in Section 2 according to the performance of SNL U.S. Equity REIT index. ***,**,and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 4: REIT Stock Price Volatility and Asymmetric Inflation Shocks

	$\hat{\pi}_t$	$\hat{\varepsilon}_t$	$\hat{\varepsilon}_t * Dum$	R^2	obs
sample					
Equity	-0.0058	-0.0222***	0.0326***	0.23	180
Hotel	-0.0054***	-0.0267***	0.0318***	0.34	180
Industrial	-0.0051***	-0.0262***	0.0346***	0.29	180
Multifamily	-0.0034***	-0.0215***	0.0284***	0.27	180
Office	-0.0043***	-0.0218***	0.0280***	0.3	180
Retail	-0.0035***	-0.0226***	0.0304***	0.28	180
Up market					
Equity	-0.0034***	-0.0060**	0.0111***	0.41	129
Hotel	-0.0070***	-0.0127***	0.0152**	0.48	129
Industrial	-0.0063***	-0.0123***	0.0185***	0.46	129
Multifamily	-0.0052***	-0.0109***	0.0152**	0.42	129
Office	-0.0056***	-0.0101***	0.0136**	0.44	129
Retail	-0.0052***	-0.0107***	0.0159***	0.41	129
Down market					
Equity	-0.004	-0.0359***	0.0414**	0.49	51
Hotel	-0.003	-0.0396***	0.0386*	0.41	51
Industrial	-0.0035	-0.0397***	0.0423*	0.35	51
Multifamily	-0.0003	-0.0304***	0.0314*	0.34	51
Office	-0.0023	-0.0327***	0.0351*	0.37	51
Retail	-0.0007	-0.0331***	0.0352*	0.36	51

The table presents coefficient estimates for REIT stock price volatility and inflation risk regression. The dependent variable is monthly volatility for the daily return of different REIT index with various sector focus. Equity represents the SNL U.S Equity REIT Index. $\hat{\pi}_t$ is the coefficient for expected inflation. $\hat{\varepsilon}_t$ is the coefficient for unexpected inflation. $\hat{\varepsilon}_t * Dum$ is the coefficient for cross term of expected inflation and dummy variable. Dummy variable equals 1 if the error term is positive and 0 otherwise. Up market and down market is defined in Section 2 according to the performance of SNL U.S. Equity REIT index. ***,**,and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 5: REIT Return Volatility and Trading Activities

	$Vol_{i,t}(10^{-8})$	R^2	obs
Sample	3.4***	0.1	35215
Up market	2.15***	0.04	25854
Down market	4.16***	0.16	9361

The table presents coefficient estimates for REIT stock price volatility and trading volume regression. The dependent variable is the monthly stock return volatility for a REIT stock i at month t. The independent variableVol is the month average daily trading volume for REIT stock i at month t scaled by 10^{-8}. Up market and down market is defined in Section 2 according to the performance of SNL U.S. Equity REIT index. ***,**,and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 6: Top ETF Index Components REITs

Top 10 Holding Companies	VNQ	IYR	RWR
Simon Property Group Inc	9.10%	8.34%	10.24%
Equity Residential	4.60%	4.15%	5.08%
Public Storage	4.60%	4.21%	5.16%
Vornado Realty Trust	4.30%	4.47%	5.81%
HCP Inc.	4.20%	3.78%	4.18%
Boston Properties Inc.	3.80%	3.57%	4.34%
Host Hotels & Resorts Inc.	3.70%	3.50%	3.59%
AvalonBay Communities Inc.	3%	2.76%	3.34%
Ventas Inc.	2.60%		3.04%
ProLogis	2.50%	2.40%	
Annaly Capital Mgt Inc.		2.76%	
Kimco Realty Corp			2.39%
Total	42.40%	40.33%	47.17%

This table presents the percentage of value for the REIT company out of the total value for the corresponding REIT ETF. The REITs listed are the top ten companies in the top 3 U.S REIT ETFs , namely VNQ, IYR, RWR.

Table 7: REITs Return Volatility and ETF Trading

	I_{index}	$I_{t\geq 2004}$	$I_{index,t\geq 2004}$	R^2	obs
Sample	-0.005***	0.005***	0.006***	0.07	11989

The table presents coefficient estimates for REIT volatility and ETF trading regression. I_{index} is the index dummy, which equals to 1 for ETF index REIT and 0 otherwise. $I_{t\geq 2004}$ is the year dummy, which equals 1 for year after 2004 and 0 otherwise. $I_{index,t\geq 2004}$ is the coefficient for cross term of index dummy and year dummy. ***,**,and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Table 8: Pooling Regression

	Model 1			Model 2			Model 3		
	Sample	Down	Up	Sample	Down	Up	Sample	Down	Up
DY_{t-1}	-0.3	-0.45	-0.25*	-0.35*	-0.44	-0.45*	-0.15	0.02	-0.45*
$ROAE_{t-1}$	-0.71**	-1.11*	-0.60**	-0.46*	-0.82	-0.34	-0.45*	-0.35	-0.03
NAV_{t-1}	-0.10	-0.63	-0.05	0.23	0.20	0.22	0.25	-0.49	0.02
D/E_t	0.40*	0.29	0.51**	1.14*	0.32	1.62**	1.15*	-0.20	1.62*
D/E_{t-1}	-0.14	-0.43	-0.43	0.68	0.55	0.57	0.53	0.96	0.57
SD/D_t				0.01	0.02	-0.01	0.005	0.02	-0.01
ETF							-0.004	0	-0.004
$Year$							0.01***	0.02***	0.0001
R^2	0.03	0.02	0.06	0.12	0.03	0.24	0.17	0.24	0.24
Obs	8949	2166	6192	2072	540	1397	2072	540	1397

The table presents coefficient estimates for REIT volatility, economic activities, leverage and year effect. All variables are defined as before. Up market and down market is defined in Section 2 according to the performance of SNL U.S. Equity REIT index. ***,**,and * denote statistical significance at 1%, 5%, and 10% levels, respectively.