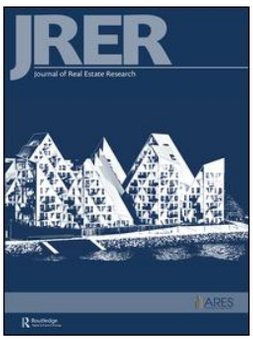

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The Determinants of the Ex Ante Risk Premium in Commercial Real Estate

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Abstract

We investigate the determinants of the ex ante risk premium in commercial real estate. Using a 20-year time series and Markov-switching regression, we find that the ex ante risk premium is affected by fundamental and non-fundamental determinants, albeit not symmetrically when risk premiums are increasing and decreasing. In particular, we find that changes in debt capital market conditions have a higher predictive power for changes in the ex ante risk premium when it is increasing, while changes in stock market volatility and commercial real estate market returns have a higher predictive power when the risk premium is on the decline. In addition, changes in commercial real estate sentiment and NAREIT returns can predict changes in the ex ante risk premium; however, the predictive power of these variables varies across property types and risk premium (risk perception) states.

Keywords:

commercial real estate market, ex ante risk premium, risk perception, regime switching, time series analysis

When assessing investment risk and determining an adequate compensation, investors are faced with uncertainty as they typically do not have access to all the relevant information (Baz et al., 1999; Hirshleifer, 2001). This uncertainty is even more pronounced in commercial real estate markets that are characterized by informational inefficiencies, proprietary information, and segmentation. Thus, the following question arises: What information sources do investors use to assess real estate investment risk and determine their required ex ante risk premium?

The purpose of this study is to analyze the fundamental and non-fundamental determinants of the expected (ex ante) real estate risk premium. Such an

investigation is highly relevant, as real estate asset pricing requires an understanding of the returns commercial real estate investors expect. In fact, changes in the required rate of return have been identified as the main drivers of commercial real estate price movements (Duca and Ling, 2015). During periods of major market movements, expected returns, not operating cash flows, are the most important determinant of real estate values (Geltner and Mei, 1995; Clayton, 1996). Up to 30% of the variability in realized real estate returns can be explained by expected return variability (Plazzi, Torous, and Valkanov, 2010). However, to model the expected return and price real estate assets, the determinants of the real estate risk premium must be identified.

Our investigation distinguishes itself from previous studies in a number of ways. First, previous studies predominantly investigate the real estate risk premium based on the capitalization rate (e.g., Chichernea et al., 2008; Chervachidze, Costello, and Wheaton, 2009; Chervachidze and Wheaton, 2013) or realized total returns (e.g., Clayton, 1996; Ho, Addae-Dapaah, and Glascock, 2015). However, realized capitalization rates have limited predictive power for expected returns across all property types (Plazzi, Torous, and Valkanov, 2010) and do not capture the capital appreciation expectations of investors. Furthermore, a major shortcoming of using realized data is that it underestimates the ex ante risk investors face (Bond, Hwang, Lin, and Vandell, 2007; Lin and Vandell, 2007; Lin and Liu, 2008). The ex ante risk premium can be substantially larger than realized risk premiums (Shilling, 2003; Lin and Liu, 2008), thus the ex ante risk perception of investors may be different from the risk perception incorporated into the realized risk premium.

However, except for Shilling (2003), Clayton, Ling, and Naranjo (2009), and Duca and Ling (2015), the ex ante real estate risk premium has received little attention in the real estate literature. In our empirical investigation, we define the ex ante risk premium as the difference between the expected return of investors surveyed by the Real Estate Research Corporation (RERC)/Situs RERC and the yield on 10-year Treasury bonds. We also derive an alternative ex ante risk premium based on the National Council of Real Estate Investment Fiduciaries (NCREIF) Property Index (NPI) capitalization rates and the 10-year expected inflation as an approximation of long-term appreciation.

Second, the real estate risk premium varies over time (Clayton, 1996; Plazzi, Torous, and Valkanov, 2008, 2010). In our investigation, we account for the fact that the risk perception of real estate investors and the sources of information used in their risk assessment are likely to vary across market cycles. Institutional investors, for example, can be highly sensitive to liquidity risk (Dhar and Goetzmann, 2006). Considering that investors are much more sensitive to potential losses than to gains, in line with the prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992; Barberis, 2013), their higher sensitivity to losses is likely to impact their risk perception and premium requirements in times of deteriorating markets. Furthermore, during periods of declining trading volumes in commercial real estate markets and an increasing risk perception, there is typically less information available to investors (Shilling, Sirmans, and Slade,

2013) to assess risk than during periods of increasing trading volumes, when more frequent up-to-date information is typically available (Scofield, 2013). As a consequence, we hypothesize that fundamental and non-fundamental information factors have an asymmetric effect on the ex ante risk premium, depending on whether investor risk perception (premium) is increasing or decreasing.

Using time series data for the 1994:Q2–2015:Q4 period and Markov-switching regression, we find that fundamental and non-fundamental factors can predict the ex ante risk premium, albeit asymmetrically. Changes in debt capital market conditions appear to have a higher predictive power for changes in the ex ante risk premium in times of an increasing risk premium (risk perception). On the other hand, changes in stock market volatility and commercial real estate market returns have a higher predictive power in times of a decreasing risk premium (risk perception). While changes in real estate sentiment and NAREIT returns affect changes in the ex ante risk premium, the predictive power of these variables for changes in the risk premium varies across property types and risk perception states.

The remainder of this paper is structured as follows. We review the related literature, and then discuss our methodology, data, and results. The paper closes with concluding remarks and discussions.

Literature Review

A number of studies have identified the fundamental macroeconomic, property, and capital market factors that affect the real estate risk premium. Clayton (1996) concludes that the variation in the ex post real estate risk premium is strongly related to economic conditions. This is in line with Ho, Addae-Dapaah, and Glascock (2015), who provide evidence of an impact of the overall economy, as measured by GDP, on the ex post risk premium. Additionally, the debt capital market has been identified as a particularly important determinant of the real estate risk premium. Studies focusing on capitalization rates as a measure of the real estate risk premium find the debt capital market in general and the availability of debt capital in particular have the largest impact on capitalization rates (Chichernea et al., 2008; Chervachidze, Costello, and Wheaton, 2009; Clayton, Ling and Naranjo, 2009; Chervachidze and Wheaton, 2013). The dispersion in realized real estate returns across different geographic markets is also affected by capital market factors, such as term structure or credit risk spread (Plazzi, Torous, and Valkanov, 2008).

In addition to macroeconomic and capital market factors, property market fundamentals affect investors' perceived investment risk and consequently their required risk premium (Clayton, 1996; Sivitanidou and Sivitanides, 1999; D'Agensio and Laurin, 2009). Clayton, Ling, and Naranjo (2009) show that expected changes in market rental rates have a negative relation with changes in capitalization rates perceived by commercial real estate market participants, based

on the RERC/Situs RERC survey, for a number of property types, such as office and malls. Chichernea et al. (2008) show that property market characteristics, such as supply constraints or market liquidity, lead to geographical variation in the realized real estate risk premium based on capitalization rates. This geographical dispersion has also been observed for realized commercial real estate market returns and the implied risk premium capturing idiosyncratic risk exposure across different geographical markets. However, the cross-sectional dispersion in real estate returns is primarily driven by changes in macroeconomic variables (Plazzi, Torous, and Valkanov, 2008).

Real estate investment trust (REIT) returns in the more informationally efficient and liquid stock market are likely to also have informative value for commercial real estate investors assessing their ex ante risk premium. Ling and Naranjo (2015) show that REIT returns incorporate fundamental information about the commercial real estate market more quickly than private market returns. Li, Mooradian, and Yang (2009) conclude that NCREIF indices incorporate information from the NAREIT indices, which provides further evidence that REIT market information has informative value to commercial real estate investors and appraisers, and thus serves as a predictor for private market returns (e.g., Giliberto, 1990; Barkham and Geltner, 1995; Oikarinen, Hoesli, and Serrano, 2011; Yunus, Hansz, and Kennedy, 2012), albeit with limitations (Ling and Naranjo, 2015).

Studies suggest that investor sentiment is one explanation for the time variation in the real estate risk premium (Clayton, 1996; Clayton, Ling, and Naranjo, 2009). We define sentiment as expectations of commercial real estate investors about future cash flows and risks that are not entirely based on fundamentals. This definition is in line with Baker and Wurgler (2007). The characteristics of commercial real estate, such as heterogeneity, segmentation, and a high degree of illiquidity, lead to informational inefficiencies, which make it difficult for investors to accurately assess their risk. Commercial real estate investors have been found to use their emotions/feelings and the opinions of others to complement fundamental information and compensate for the lack of other fundamental data (Gallimore and Gray, 2002). As a consequence, sentiment can affect investor behavior (Freybote and Seagraves, 2017) and be employed to help predict commercial real estate returns and market liquidity (Ling, Naranjo, and Scheick, 2014; Marcato and Nanda, 2016; Freybote and Seagraves, 2018). Apart from their own sentiment, investors may also monitor the overall market sentiment (i.e., opinions of others), based on, for example, RERC/Situs RERC survey responses or buy-sell imbalances in the private real estate market (Clayton, Ling, and Naranjo, 2009).

Clayton (1996) suggests that expected returns might reflect both fundamental factors and non-fundamental factors. Clayton, Ling, and Naranjo (2009) are the first to investigate the impact of investor sentiment on capitalization rates beyond fundamental factors (e.g., expected rental growth or interest rates). The authors use survey-based capitalization rates observed by commercial real estate market participants and assume a linear relation between investor sentiment and

capitalization rates over time. They find that changes in investor sentiment negatively affect changes in capitalization rates in the short run. In particular, increases in positive sentiment (optimism) lead to decreases in these rates. This finding is in line with Chervachidze, Costello, and Wheaton (2009), who use a different methodology and find further evidence that investor sentiment impacts capitalization rates. Investor sentiment has also been found to affect realized real estate returns in the short run (Ling, Naranjo, and Scheick, 2014).

In addition to commercial real estate sentiment, stock market volatility is likely to also have predictive power for the ex ante risk premium. Considering that the space demand for the majority of property types is affected by economic conditions, stock market volatility is likely to have informative value for investors in a derivative asset market such as commercial real estate. Stock market volatility is captured by implied volatilities based on S&P 500 Index option prices from the Chicago Board Options Exchange (CBOE). It has been found to affect single-family home prices (Wain, Graham, Burrus, and Moffett, 2013), while REIT returns fail to demonstrate sensitivity to changes in stock market volatility (DeLisle, Price, and Sirmans, 2013). However, no previous study has investigated the impact of stock market volatility on the ex ante risk premium in commercial real estate markets.

Methodology

Theoretical and empirical evidence suggest that the relations of fundamental and non-fundamental factors with the ex ante risk premium are non-linear and vary across different states of the economy. First, there is a time variation in expected returns and consequently the real estate risk premium (Clayton, 1996; Plazzi, Torous, and Valkanov, 2008, 2010). Second, investor risk perception is asymmetric over good and bad market conditions, which is in line with the prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992; Barberis, 2013). Third, the availability of information varies greatly across different states of market liquidity (Scofield, 2013; Shilling, Sirmans, and Slade, 2013), which affects the uncertainty investors encounter when assessing investment risk.

To reflect the hypothesized non-linear relation between determinants and the ex ante risk premium, we apply a Markov-switching regression in our empirical analysis. Regime-switching methodologies have been employed in REIT (Lizieri, Satchell, Worzala, and Dacco, 1998; Anderson, Boney, and Guirguis, 2012; Bianchi and Guidolin, 2014; Chou and Chen, 2014; Liow and Ye, 2017), commercial real estate (Freybote and Seagraves, 2018), and housing market (Miles, 2008; Huang, 2013; Nneji, Brooks, and Ward, 2013) studies. The Markov-switching regression estimates the transition of a time series; in our case, the ex ante risk premium is based on a Markov-switching process over a set of regimes or states. For our investigation, we assume two states: an increasing real estate risk premium and a decreasing real estate risk premium. In our Markov-switching regression, we assume that an economic or financial time series changes its

behavior over time, either due to structural, temporary or recurrent changes. Thus, the parameters of the model differ between states (Piger, 2011).

The challenge of modeling different states of the expected real estate risk premium is that the dates for different risk premium regimes are not known. While a regression with a dummy variable for periods of an increasing or decreasing risk premium requires that start and end dates for each regime are known, the Markov-switching methodology does not require this information. Instead, states in the Markov-switching regression are based on a Markov chain, in which the probability of a future state is conditional on the present state, i.e., a serial dependence exists between two adjacent periods (Piger, 2011). Another advantage of the Markov-switching regression over alternative methodologies is that the regime shifts between states are based on the time series data itself, not tied to an observed variable identified by the researcher or selected dates, which may be arbitrary to some degree (Piger, 2011).

To emphasize the difference between the non-linear Markov-switching regression and a linear bivariate vector autoregression (VAR) for different risk premium states, we first conduct a VAR for the changes in the expected risk premium and changes in the (1) overall economic conditions based on economic, property, and capital market fundamentals, (2) stock market volatility, and (3) commercial real estate market sentiment, respectively, as shown in equation (1). We conduct the respective VARs separately for periods with an increasing or decreasing risk premium:

$$\begin{bmatrix} y_{1,t} \\ y_{2,t} \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \end{bmatrix} + \begin{bmatrix} A_{1,p} \\ A_{2,p} \end{bmatrix} \begin{bmatrix} y_{1,t-p} \\ y_{2,t-p} \end{bmatrix} + \begin{bmatrix} e_{1,t} \\ e_{2,t} \end{bmatrix}, \tag{1}$$

where y_1 and y_2 represent the ex ante risk premium and the respective independent variable (e.g., term structure, credit risk spread, stock market volatility, real estate market sentiment) in first differences. Endogenous variables are expressed as a linear function of their own and the other variable's lags (y_{t-p}). Last, c is a $k \times 1$ vector of constants and e is a $k \times 1$ vector of error terms.

Using the VAR approach to investigate the hypothesized non-linear relation between the ex ante risk premium and different determinants requires us to choose a start and end date for periods of an increasing or decreasing risk premium. We separate our sample into periods of a high or increasing risk premium, such as the dot-com bubble collapse from 2000 to 2002 and the financial crisis of 2007 to 2009, and periods of a low or decreasing risk premium, which are the remaining quarters in our sample. This approach ensures that, for example, a quarter with a positive risk premium change during the 2007–2009 financial crisis is nevertheless included in the sub-sample representing periods of an overall high or increasing risk premium. However, the difficulty of unambiguously defining high and low

risk premium periods emphasizes the shortcomings of the VAR approach for our investigation and provides support for our use of the Markov-switching regression.

To be able to compare the results of the VAR with the results of the Markov-switching regression, lags for the VAR models are chosen based on the lags selected for the Markov-switching regressions. We also employ the Schwarz information criterion (SIC) to investigate the appropriate lags for our VAR in different risk premium states. Ivanov and Killian (2005) show that the SIC is the most accurate approach for quarterly VAR models with a sample size of less than 120. For our subsample of quarters of an increasing risk premium ($N = 24$), the SIC-minimizing model contains zero lags for all endogenous variables, except for the *VIX* (one lag). For our subsample of quarters of a decreasing risk premium ($N = 61$), the SIC-minimizing model for all variables has zero lags. In addition to conducting the lag selection diagnostics, we estimate our VAR models with different lag lengths, and our results remain robust.

Our Markov-switching autoregressive model is:

$$y_t = \alpha_{S_t} + X_t\beta_{S_t} + \phi_p y_{t-p} + \varepsilon_{S_t}$$
$$\alpha_t = S_t\alpha_1 + (1 - S_t)\alpha_2, \qquad (2)$$

where y_t is the ex ante real estate risk premium, α_{S_t} is the state-dependent intercept, i.e., α_1 for risk premium State 1 and α_2 for risk premium State 2, S_t is the unobserved state, β_{S_t} are the state-dependent coefficients for the lags of the respective fundamental or non-fundamental determinants X, and ϕ_p is an autoregressive coefficient and captures the autoregressive components of the risk premium. All variables are in first differences. In our analysis, we choose three lags and an autoregressive term (ϕ_p) of 2 (AR(2)), as these minimize the Akaike information criterion (AIC), Hannan and Quinn information criterion (HQIC), and Schwarz information criterion (SIC) statistics for the respective Markov-switching regression without conflict.

Data

To derive the ex ante risk premium, we follow Clayton, Ling, and Naranjo (2009) and obtain quarterly survey data from the *Real Estate Report* of the Real Estate Research Corporation (RERC) for the 1993:Q1–2013:Q4 period and from Situs RERC for the 2014:Q1–2015:Q4 period. One question in the RERC/Situs survey asks respondents to provide their expected return in terms of pre-tax yield/IRR (Duca and Ling, 2015). Based on information provided by Situs RERC for 2014 and 2015, the average holding period assumed by respondents is nine years. We use the required return from the survey for office, industrial, retail, and apartment and define the ex ante risk premium (RP_{RERC}) as the difference between the

quarterly required return and the risk-free rate, which we define as the yield on the 10-year Treasury bond, as in Clayton, Ling, and Naranjo (2009). We employ an aggregated ex ante risk premium based on the average required return across all property types (office, industrial, retail, and apartment), as well as disaggregated property type-specific ex ante risk premiums.

As an alternative to the survey-based risk premium, we derive an NCREIF-based ex ante risk premium (RP_{NCREIF}). We follow Clayton, Ling, and Naranjo (2009) and employ the NCREIF Property Index (NPI) capitalization rate. We derive an expected return based on the sum of the annualized NPI income return (capitalization rate) and an approximation of capital gains. We approximate long-term capital gains using the expected 10-year inflation provided by the Federal Reserve Bank of Cleveland, due to the fact that, fundamentally, property price appreciation cannot materially outpace inflation in the long run. In fact, the NCREIF price appreciation and expected 10-year inflation were very similar (2.4% and 2.7%, respectively, with a positive correlation of 82.20%[1]) over the 1982:Q4–2016:Q1 period. After constructing the expected return from the appraisal-based NPI information, we calculate the ex ante risk premium, which represents the spread of this expected return above the 10-year Treasury bond yield.

We include a number of fundamental variables in our analysis. To reflect the importance of economic conditions for the risk premium investors require, and in line with Clayton (1996) and Ho, Addae-Dapaah, and Glascock (2015), we also include the quarterly unemployment rate (*UNEMP*) in the United States. Next we capture fundamental information about debt capital markets that have been found to explain the real estate risk premium (Plazzi, Torous, and Valkanov, 2008; Chichernea et al., 2008; Chervachidze, Costello, and Wheaton, 2009; Clayton, Ling, and Naranjo, 2009; Chervachidze and Wheaton, 2013) by including the term structure (*TERM*), defined as the spread between the yield of 10-year Treasury bonds and the yield of 3-month Treasury bills, and the credit risk spread (*SPR*), defined as the spread between the yield on BAA- and AAA-rated corporate bonds. To reflect the importance of commercial real estate market conditions for the real estate risk premium (Clayton, 1996; Sivitanidou and Sivitanides, 1999; Chichernea et al., 2008; Clayton, Ling, and Naranjo, 2009; D'Agensio and Laurin, 2009), we include the total return on the NCREIF transaction-based index (*NTBI*).[2] Last, to account for the informative value of the REIT market (Li, Mooradian, and Yang, 2009; Ling and Naranjo, 2015), we include the total return on the NAREIT equity REIT index (*NAREIT*). For analyses disaggregated by property type, we employ the total return on the property type-specific NTBI and NAREIT indices.

To examine the relation between changes in economic conditions and changes in the ex ante risk premium, we first derive a fundamental factor (*FUND*) from economic, capital market, and commercial real estate market variables using principal component analysis. *FUND* is the first component with the largest eigenvalue, and unemployment (*UNEMP*), credit risk spread (*SPR*), and term structure (*TERM*) load positively onto this factor while the total return on the *NTBI* and *NAREIT* indices load negatively. Thus, the higher this fundamental

factor (*FUND*), the worse are economic conditions. In a second step, we furthermore analyze the relations between changes in individual economic fundamentals and changes in the ex ante risk premium.

Stock market volatility (*VIX*) is measured by the Chicago Board Options Exchange (CBOE) Volatility Index (VIX). This index, also known as ''fear index,'' captures expectations about market volatility based on S&P 500 stock index option prices. The higher the VIX is, the higher are stock market investors' expectations about market volatility.

In line with Clayton, Ling, and Naranjo (2009) and Ling, Naranjo, and Scheick (2014), we measure commercial real estate investor sentiment ($SENT_{RE}$) based on the quarterly RERC/Situs RERC survey. Amongst other items, the survey asks respondents to rank investment conditions in different typological and geographical commercial real estate markets. To measure the overall investor sentiment for all property types included in the analysis, we use principal component analysis to derive the first principal component with the highest eigenvalue. We employ the same approach to derive the office, industrial, and retail sentiment measure, as RERC/Situs RERC reports investment conditions for different sub-categories of these property types. While the RERC investor sentiment measure has been found to be correlated with NCREIF returns in prior years and of limited predictive power for future return performance (Ling, 2005), this survey item nevertheless reflects a consensus opinion of current investment conditions that is likely based on a mix of fundamental information and irrationality.

As we are interested in the relation between changes in different determinants and changes in the ex ante risk premium, we take the first difference for each variable. All differenced variables are stationary at the 1% level (augmented Dickey-Fuller test). Exhibit 1 provides the summary statistics of our leveled and differenced variables. The mean ex ante risk premiums (RP_{RERC} and RP_{NCREIF}) are 5.39% and 5.07%, respectively. Standard deviations and medians for both risk premiums are relatively similar. Exhibit 2 presents a visual depiction of the relation between both ex ante risk premiums. It shows that the risk premiums behave in a similar manner over time. This suggests that, consistent with Clayton, Ling, and Naranjo's (2009) findings, the NCREIF NPI and RERC/Situs RERC risk premium have a close connection. Interestingly, between 1994 and 1999, the RERC/Situs RERC risk premium was generally smaller than the NCREIF risk premium, while from 2000 onwards, the former exceeded the latter.

As shown in Exhibit 3, changes in the RERC/Situs RERC and NCREIF-based ex ante risk premia have a statistically significant positive correlation of 0.56 across the entire sample period. However, when there is a higher/increasing risk premium (2000–2002 and 2007–2009), this correlation decreases to 0.45; when there is a decreasing or lower risk premium, this correlation increases to 0.59. These changes in the pairwise correlation between RP_{RERC} and RP_{NCREIF} may indicate that they are driven by different factors across different risk premium regimes.

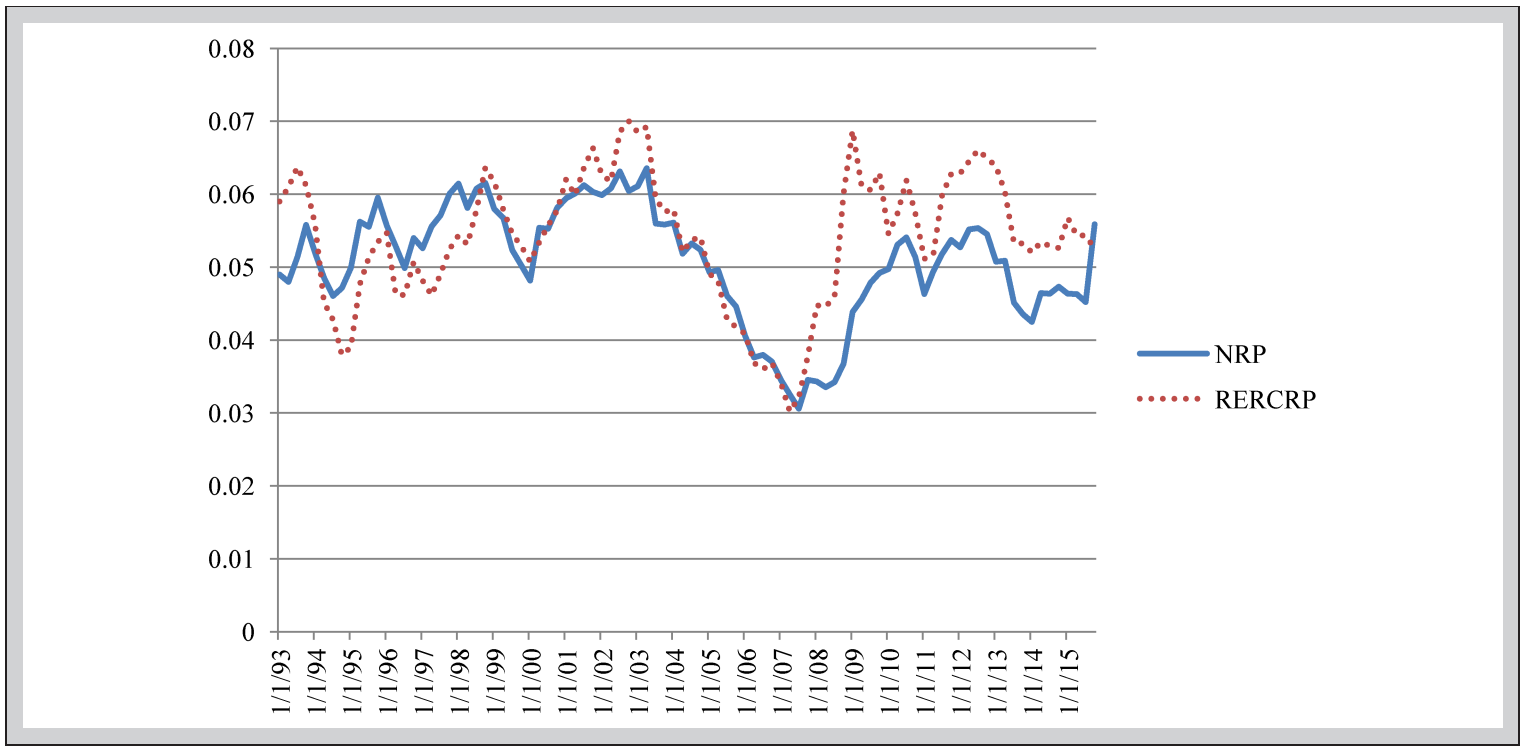
Exhibit 1 | Summary Statistics

Variable	Mean	Median	Std. Dev.	Min.	Max.
Level Variables					
RP_{RERC}	0.054	0.055	0.01	0.03	0.07
RP_{NCREIF}	0.051	0.052	0.01	0.03	0.06
SPR	0.96	0.87	0.38	0.59	2.50
TERM	1.77	1.93	1.07	−0.25	3.43
$SENT_{RE}$	0.001	0.41	2.06	−6.12	2.70
NTBI	0.02	0.02	0.06	−0.17	0.18
NAREIT	0.03	0.03	0.05	−0.18	0.20
VIX	20.14	19.90	6.52	12.39	40.52
UNEMP	6.03	5.61	1.61	3.97	9.74
Differenced Variables					
RP_{RERC}	−0.01	−0.004	0.43	−1.07	1.41
RP_{NCREIF}	0.01	−0.004	0.30	−0.76	1.07
SPR	0.003	0.001	0.13	−0.49	0.51
TERM	−0.01	−0.05	0.29	−0.57	0.86
$SENT_{RE}$	0.03	0.03	0.46	−1.19	1.10
NTBI	−0.001	0.002	0.09	−0.23	0.27
NAREIT	0.00	0.001	0.04	−0.08	0.12
VIX	0.04	0.10	2.16	−8.88	4.72
UNEMP	−0.02	−0.08	0.26	−0.34	0.91

Notes: This table presents the summary statistics for the following variables in level and first difference over the 1994:Q1–2015:Q4 period ($N = 92$). RP_{RERC} is the expected (ex ante) risk premium based on the average expected IRR of investors for office, industrial, retail, and apartment (surveyed by the RERC/Situs RERC) and the risk-free rate. RP_{NCREIF} is the expected (ex ante) risk premium based on the income return on the overall NCREIF index (cap rates) plus expected 10-year inflation and the risk-free rate. *SPR* is the credit risk spread defined as difference in yields between BAA- and AAA-rated corporate bonds. *TERM* is the term structure based on the difference in yields between 10-year Treasury bonds and 3-month Treasury bills. $SENT_{RE}$ measures commercial real estate investor sentiment and is based on investment conditions perceived by investors (RERC/Situs RERC survey). *NTBI* is the total return on the NCREIF transaction-based index. *NAREIT* is the total return on the NAREIT equity index. *VIX* measures implied stock market volatility (S&P 500) based on the Chicago Board Options Exchange (CBOE) volatility index. *UNEMP* is the quarterly U.S. unemployment rate.

Exhibit 3 also presents the pairwise correlations of fundamental and non-fundamental sources of information for both ex ante risk premiums over the entire period, as well as separated by period. For the full period, changes in the credit risk spread (*SPR*), stock market volatility (*VIX*), and unemployment (*UNEMP*) have a statistically significant positive correlation with changes in RP_{RERC}. On the other hand, changes in real estate sentiment ($SENT_{RE}$) and term structure (*TERM*) have a statistically significant negative correlation. In times of a higher/increasing risk premium (2000–2002 and 2007–2009), credit risk spread (*SPR*) and stock

Exhibit 2 | RP_{NCREIF} and RP_{RERC}



This graph presents the RP_{NCREIF} (*NRP*) and RP_{RERC} (*RERCRP*) over the period of 1994:Q1 to 2015:Q4. RP_{RERC} is the expected (ex ante) risk premium based on the average expected IRR of investors for office, industrial, retail, and apartment (surveyed by the RERC / Situs RERC) and the risk-free rate. RP_{NCREIF} is the expected (ex ante) risk premium based on the income return on the NCREIF index (cap rates) plus expected 10 year inflation and the risk-free rate.

Exhibit 3 | Pairwise Correlations of Differenced Variables

	Full Period		Increasing Risk Premium		Decreasing Risk Premium	
	RP_{RERC}	RP_{NCREIF}	RP_{RERC}	RP_{NCREIF}	RP_{RERC}	RP_{NCREIF}
RP_{RERC}	1.00		1.00		1.00	
RP_{NCREIF}	0.56***	1.00	0.45**	1.00	0.59***	1.00
SPR	0.41***	0.12	0.56***	0.03	0.33***	0.26**
TERM	−0.34***	−0.37***	−0.15	−0.31	−0.67***	−0.55***
$SENT_{RE}$	−0.17*	−0.03	−0.18	0.24	−0.09	−0.05
NTBI	−0.05	0.02	0.03	0.34	−0.07	−0.05
NAREIT	−0.14	0.08	−0.58***	−0.07	0.15	0.17
VIX	0.40***	0.06	0.59***	−0.01	0.24*	0.11
UNEMP	0.35***	0.24**	0.25	0.32	0.26**	0.12

Notes: This table presents pairwise correlations for the first differences of the following variables over the period of 1994:Q2 to 2015:Q4 ($N = 86$). RP_{RERC} is the expected (ex ante) risk premium based on the average expected IRR of investors for office, industrial, retail, and apartment (surveyed by the RERC/Situs RERC) and the risk-free rate. RP_{NCREIF} is the expected (ex ante) risk premium based on the income return on the overall NCREIF index (cap rates) plus expected 10 year inflation and the risk-free rate. *SPR* is the credit risk spread defined as difference in yields between BAA- and AAA-rated corporate bonds. *TERM* is the term structure based on the difference in yields between 10-yr Treasury bonds and 3-month Treasury bills. $SENT_{RE}$ measures commercial real estate investor sentiment and is based on investment conditions perceived by investors (RERC/Situs RERC survey). *NTBI* is the total return on the NCREIF transaction-based index. *NAREIT* is the total return on the NAREIT equity index. *VIX* measures implied stock market volatility (S&P 500) based on the Chicago Board Options Exchange (CBOE) volatility index. *UNEMP* is the quarterly U.S. unemployment rate. The increasing risk premium period is defined as periods of crisis (2000 to 2002; 2007 and 2009; $N = 24$) while decreasing risk premium periods represent all other quarters ($N = 64$).

* Statistically significant at the 10% level.

** Statistically significant at the 5% level.

*** Statistically significant at the 1% level.

market volatility (*VIX*) have a statistically significant positive correlation with RP_{RERC}, while the total return on the NAREIT Index (*NAREIT*) has a negative correlation. In the lower/decreasing risk premium period, pairwise correlations of RP_{RERC} and independent variables (except $SENT_{RE}$) are in line with the full period.

Compared to the RERC/Situs RERC risk premium, the NCREIF-based risk premium has fewer significant correlations with fundamental and non-fundamental variables. In particular, in the full period, unemployment and term structure have statistically significant pairwise correlations with RP_{NCREIF}. In the increasing/

higher risk premium period, RP_{NCREIF} has no significant correlations with the independent variables, while in the lower/decreasing risk premium period, debt capital market conditions have significant correlations with this risk premium. The pairwise correlations in Exhibit 3 provide initial evidence that (1) the RERC/Situs RERC and NCREIF-based risk premiums may differ in their drivers to some extent, and (2) the impact of fundamental and non-fundamental information on either risk premium is asymmetric. These findings are in line with our expectations.

Results

Our results for the bivariate VAR of changes in the RERC/Situs RERC-based risk premium and changes in the fundamental factor (*FUND*), the stock market volatility (*VIX*), and the commercial real estate risk premium ($SENT_{RE}$) are presented in Exhibit 4. In our regressions, *Ln* represents the nth lag of the respective variable. Changes in *FUND* display no relation to changes in RP_{RERC}. In times of a decreasing risk premium, changes in stock market volatility (*VIX*) have a statistically significant positive relation with changes in RP_{RERC} (first lag), suggesting that if the expected stock market volatility increases, real estate investors increase their required ex ante risk premium. During times of an increasing risk premium, changes in commercial real estate investor sentiment ($SENT_{RE}$) have a statistically significant negative relation with changes in RP_{RERC}, suggesting that as real estate market sentiment increases, the expected risk premium decreases.

The results for the NCREIF-based risk premium are presented in Exhibit 5 and are analogous to the results in Exhibit 4. Changes in *FUND* have no relation to changes in RP_{NCREIF}, while changes in stock market volatility (first lag) have a statistically significant positive relation with changes in this risk premium during times of a decreasing risk premium. Different from the RERC/Situs RERC-based risk premium in Exhibit 4, changes in commercial real estate investor sentiment display no relation to changes in the NCREIF-based risk premium.

While the third lag of RP_{RERC} has a significantly positive relation with *FUND* (Exhibit 4), our results in Exhibit 4 suggest that changes in the RERC-based ex ante risk premium have no predictive power for changes in stock market volatility (*VIX*) and commercial real estate sentiment ($SENT_{RE}$). Analogously, the changes in the NCREIF-based ex ante risk premium have no predictive power for changes in *FUND, VIX*, or $SENT_{RE}$.

The results for the Markov-switching regression of the changes in fundamental factor (*FUND*) and RP_{RERC} are presented in Exhibit 6. The constants in each state represent the average decrease (State 1) or increase (State 2) in the risk premium. The decreasing and increasing risk premium states, identified by the Markov-switching regression, reflect the time-varying nature of the real estate risk premium (Clayton, 1996; Plazzi, Torous, and Valkanov, 2008, 2010). Considering that an

Exhibit 4 | VAR Results for RP_{RERC}

	Increasing *RP*	Decreasing *RP*		Increasing *RP*	Decreasing *RP*		Increasing *RP*	Decreasing *RP*
Equation	Coeff.	Coeff.	Equation	Coeff.	Coeff.	Equation	Coeff.	Coeff.
RP_{RERC}			RP_{RERC}			RP_{RERC}		
$L1.RP_{RERC}$	0.30	0.24*	$L1.RP_{RERC}$	0.15	0.16	$L1.RP_{RERC}$	0.17	0.22
$L2.RP_{RERC}$	−0.62**	−0.19	$L2.RP_{RERC}$	−0.66*	−0.17	$L2.RP_{RERC}$	−0.32	−0.18
$L3.RP_{RERC}$	0.32	0.12	$L3.RP_{RERC}$	0.40	0.14	$L3.RP_{RERC}$	0.32	0.10
L1.FUND	0.15	−0.04	*L1.VIX*	0.02	0.03*	$L1.SENT_{RE}$	−0.25**	−0.003
L2.FUND	−0.04	−0.01	*L2.VIX*	0.01	0.01	$L2.SENT_{RE}$	−0.10	−0.07
L3.FUND	0.07	−0.13	*L3.VIX*	0.02	0.01	$L3.SENT_{RE}$	0.07	−0.09
R^2	0.42	0.10	R^2	0.49	0.13	R^2	0.49	0.10

Exhibit 4 | (continued)

VAR Results for RP_{RERC}

	Increasing *RP*	Decreasing *RP*		Increasing *RP*	Decreasing *RP*		Increasing *RP*	Decreasing *RP*
Equation	Coeff.	Coeff.	Equation	Coeff.	Coeff.	Equation	Coeff.	Coeff.
FUND			*VIX*			$SENT_{RE}$		
$L1.RP_{RERC}$	0.19	0.06	$L1.RP_{RERC}$	−4.61	−0.21	$L1.RP_{RERC}$	0.52	−0.19
$L2.RP_{RERC}$	−0.17	−0.002	$L2.RP_{RERC}$	−8.93	−1.11	$L2.RP_{RERC}$	−0.69	0.04
$L3.RP_{RERC}$	0.36	0.40***	$L3.RP_{RERC}$	3.42	−0.09	$L3.RP_{RERC}$	0.31	−0.11
L1.FUND	0.10	−0.45***	*L1.VIX*	−0.002	−0.14	$L1.SENT_{RE}$	−0.14	−0.34**
L2.FUND	0.37	−0.27**	*L2.VIX*	0.15	−0.12	$L2.SENT_{RE}$	−0.12	0.03
L3.FUND	−0.54	0.06	*L3.VIX*	0.09	−0.06	$L3.SENT_{RE}$	−0.62**	0.24*
R^2	0.27	0.33	R^2	0.20	0.07	R^2	0.46	0.17

Notes: This table presents the VAR results for changes in the RERC survey-based risk premium and changes in (1) a fundamental factor, (2) stock market volatility, and (3) real estate market sentiment separated by periods of an increasing risk premium (2000 to 2002; 2007 to 2009; $N = 24$) and periods of a decreasing risk premium ($N = 64$). RP_{RERC} is the expected (ex ante) risk premium based on the average expected IRR of investors for office, industrial, retail, and apartment (surveyed by the RERC / Situs RERC) and the risk-free rate. *FUND* represents the first principal component with the largest Eigenvalue of the following fundamental variables: credit risk spread defined as difference in yields between BAA- and AAA-rated corporate bonds; term structure based on the difference in yields between 10-year Treasury bonds and 3-month Treasury bills; total return on the NCREIF transaction-based index (NTBI); total return on the NAREIT equity index, and the quarterly U.S. unemployment rate. Stock market volatility is measured as the implied stock market volatility (S&P 500) based on the Chicago Board Options Exchange (CBOE) volatility index (VIX). Real estate market sentiment is based on investment conditions perceived by investors (RERC / Situs RERC survey). All variables are in first differences. Small sample degrees of freedom were applied.

*Statistically significant at the 10% level.

**Statistically significant at the 5% level.

***Statistically significant at the 1% level.

Exhibit 5 | VAR Results for RP_{NCREIF}

	Increasing *RP*	Decreasing *RP*		Increasing *RP*	Decreasing *RP*		Increasing *RP*	Decreasing *RP*
Equation	Coeff.	Coeff.	Equation	Coeff.	Coeff.	Equation	Coeff.	Coeff.
RP_{NCREIF}			RP_{NCREIF}			RP_{NCREIF}		
$L1.RP_{NCREIF}$	0.10	0.01	$L1.RP_{NCREIF}$	0.02	−0.02	$L1.RP_{NCREIF}$	−0.04	0.002
$L2.RP_{NCREIF}$	0.07	0.05	$L2.RP_{NCREIF}$	0.15	0.09	$L2.RP_{NCREIF}$	0.05	0.13
$L3.RP_{NCREIF}$	−0.06	−0.09	$L3.RP_{NCREIF}$	−0.03	−0.06	$L3.RP_{NCREIF}$	0.06	−0.09
L1.FUND	0.10	0.003	*L1.VIX*	0.01	0.02*	$L1.SENT_{RE}$	−0.08	0.02
L2.FUND	−0.01	−0.05	*L2.VIX*	0.002	−0.01	$L2.SENT_{RE}$	−0.08	−0.06
L3.FUND	0.03	−0.06	*L3.VIX*	0.01	0.01	$L3.SENT_{RE}$	−0.10	−0.10**
R^2	0.18	0.02	R^2	0.13	0.08	R^2	0.28	0.09

Exhibit 5 | (continued)

VAR Results for RP_{NCREIF}

	Increasing *RP*	Decreasing *RP*		Increasing *RP*	Decreasing *RP*		Increasing *RP*	Decreasing *RP*
Equation	Coeff.	Coeff.	Equation	Coeff.	Coeff.	Equation	Coeff.	Coeff.
FUND			*VIX*			$SENT_{RE}$		
$L1.RP_{NCREIF}$	−0.59	−0.15	$L1.RP_{NCREIF}$	−3.89	0.27	$L1.RP_{NCREIF}$	0.86	−0.09
$L2.RP_{NCREIF}$	−0.18	−0.06	$L2.RP_{NCREIF}$	−8.28	−0.37	$L2.RP_{NCREIF}$	0.35	0.05
$L3.RP_{NCREIF}$	0.10	0.26	$L3.RP_{NCREIF}$	−5.19	−1.13	$L3.RP_{NCREIF}$	0.06	0.40
L1.FUND	0.08	−0.42***	*L1.VIX*	−0.26	−0.15	$L1.SENT_{RE}$	−0.16	−0.31**
L2.FUND	0.47	−0.20	*L2.VIX*	−0.37	−0.16	$L2.SENT_{RE}$	−0.03	0.02
L3.FUND	−0.45	0.09	*L3.VIX*	−0.06	−0.08	$L3.SENT_{RE}$	−0.33	0.37***
R^2	0.28	0.23	R^2	0.25	0.06	R^2	0.30	0.22

Notes: This table presents the VAR results for changes in the NCREIF-based risk premium and changes in (1) a fundamental factor, (2) stock market volatility, and (3) real estate market sentiment separated by periods of an increasing risk premium (2000–2002, 2007–2009; $N = 24$) and periods of a decreasing risk premium ($N = 64$). RP_{NCREIF} is the expected (ex ante) risk premium based on the income return on the overall NCREIF index (cap rates) plus expected 10-year inflation and the risk-free rate. *FUND* represents the first principal component with the largest Eigenvalue of the following fundamental variables: credit risk spread defined as difference in yields between BAA- and AAA-rated corporate bonds; term structure based on the difference in yields between 10-yr Treasury bonds and 3-month Treasury bills; total return on the NCREIF transaction based index (NTBI); total return on the NAREIT equity index, and the quarterly U.S. unemployment rate. Stock market volatility is measured as the implied stock market volatility (S&P 500) based on the Chicago Board Options Exchange (CBOE) volatility index (VIX). Real estate market sentiment is based on investment conditions perceived by investors (RERC survey). All variables are in first differences. Small sample degrees of freedom were applied.

*Statistically significant at the 10% level.

**Statistically significant at the 5% level.

***Statistically significant at the 1% level.

Exhibit 6 | Markov-Switching Regression Results: RP_{RERC} and Overall Economic Conditions

	All	Office	Industrial	Retail	Apartment
Decreasing *RP*					
ϕ_p	−0.13	−0.13	−0.16	−0.38***	−0.39***
Constant	−0.04	−0.16**	−0.16**	−0.02	−0.21**
L1.FUND	0.20	0.16	0.23*	0.25**	0.04
L2.FUND	−0.03	−0.06	−0.08	0.58***	0.16
L3.FUND	−0.14	−0.02	−0.06	0.14	−0.10
Sigma	0.33	0.32	0.31	0.35	0.28
Duration	2.66	4.39	3.52	12.00	3.43
P11	0.63	0.77	0.72	0.92	0.71
Increasing *RP*					
Constant	0.11	0.35***	0.29***	0.03	0.21*
L1.FUND	0.01	0.09	0.15**	0.01	0.15*
L2.FUND	0.57***	0.46***	0.57***	−0.11	0.05
L3.FUND	0.49**	0.15	0.06	−0.11	−0.08
Sigma	0.33	0.23	0.21	0.35	0.32
Duration	1.24	2.30	2.33	18.32	3.45
P22	0.20	0.57	0.57	0.95	0.71

Notes: This table presents the Markov-switching regression (autoregression) for the first difference of RP_{RERC} over the period of 1994:Q3 to 2015:Q4 ($N = 86$) and a fundamental factor. RP_{RERC} is the expected (ex ante) risk premium based on the expected IRR of investors surveyed by RERC/Situs RERC and the risk-free rate. ϕ_p captures the autoregressive components for RP_{RERC}, which is AR(2). Fundamentals represents the first principal component with the largest Eigenvalue of the following fundamental variables: credit risk spread defined as difference in yields between BAA- and AAA-rated corporate bonds; term structure based on the difference in yields between 10-yr Treasury bonds and 3-month Treasury bills; total return on the NCREIF transaction-based index (NTBI); total return on the NAREIT equity index and the quarterly U.S. unemployment rate. All variables are in first differences.

*Statistically significant at the 10% level.

**Statistically significant at the 5% level.

***Statistically significant at the 1% level.

increase (decrease) in the fundamental factor (*FUND*) indicates worse (better) economic conditions, we expect a positive relation between the changes in *FUND* and the ex ante risk premium.

For the overall ex ante risk premium (All column), changes in *FUND* have a statistically significant positive relation (second and third lag) with changes in the risk premium in times of an increasing risk premium. When fundamental conditions deteriorate (improve), commercial real estate investors increase (decrease) their risk premium requirement, which is in line with our expectations. Commercial real estate investors appear to be more sensitive to fundamental conditions in times of a heightened risk perception and increasing risk premium.

On the other hand, fundamental conditions appear to have no impact on the risk premium during times of a decreasing risk premium.

When we estimate our model for individual property types, our results for office and apartment are in line with the results for the aggregate risk premium (i.e., changes in fundamentals have a positive relation with changes in risk premium in times of an increasing risk premium). In the case of retail real estate, changes in fundamentals have a statistically significant positive relation (first and second lag) on changes in the risk premium during times of a decreasing risk premium. For industrial real estate, changes in fundamentals have a statistically significant positive relation with changes in the risk premium in both periods, albeit the effect is stronger and covers two lags during times with an increasing risk premium. Overall, our results in Exhibit 6 suggest that fundamental conditions have an asymmetric relation with the ex ante risk premium and more predictive power when there is an increasing risk premium (except for retail).

In addition to estimating the coefficients for the determinants in the two risk premium states, the Markov-switching regression provides insights into the regime-switching process, duration in quarters, and persistence of states. The predicted duration for each state (*Duration*) indicates which state of the ex ante risk premium lasts longer. In Exhibit 6, the duration of the decreasing risk premium state, in terms of quarters, is larger than the duration of the increasing risk premium state for all, office, and industrial. For apartment and retail, the increasing risk premium state lasts longer than the decreasing, albeit the difference is small for apartment. Exhibit 6 also reports the transition probabilities (P11 and P22), which represent the probability of staying in one particular state in the next quarter given that the Markov process is in this state currently. Conversely, the probability of moving from one state to the other in two subsequent quarters (P12 and P21; not reported in Exhibit 6) is the difference between one and P11 and P22, respectively. As suggested by the transition probabilities P11 and P22, periods of a decreasing risk premium (State 1) are more persistent than periods of an increasing risk premium (State 2) for all, office, and industrial. For retail, the increasing risk premium state is more persistent, while for apartment, both states are equally persistent. Last, increasing and decreasing risk premium states exhibit different levels of volatility (sigma) for a number of property types (office, industrial, and apartment), which provides support for our hypothesis of regime-switching (Anderson, Boney, and Guirguis, 2012).

To provide more insights into the relations between changes in individual fundamental factors and changes in the aggregated ex ante risk premium, we present the Markov-switching results for credit risk spread, term structure, unemployment, and total return on the NTBI and NAREIT indices in Exhibit 7. As the third lag of *FUND* is statistically insignificant for all individual property types (Exhibit 6), we only include the first two lags of each fundamental variable in our Markov-switching regression. Changes in debt capital market conditions (*SPR* and *TERM*) have a statistically significant positive relation with the ex ante risk premium during times of an increasing risk premium. While the impact of

Exhibit 7 | Markov-Switching Regression Results: RP_{RERC} and Individual Fundamentals

	SPR	*TERM*	*UNEMP*	*NTBI*	*NAREIT*
Decreasing *RP*					
ϕ_p	−0.35**	−0.31**	−0.24	−0.27**	−0.34***
Constant	−0.20**	−0.18***	−0.20***	−0.25***	−0.18***
L1.Predictor	−0.20	0.07	−0.54**	−2.98***	−0.01
L2.Predictor	0.36	0.11	0.45**	−0.67	0.01
Sigma	0.35	0.34	0.32	0.18	0.34
Duration	5.38	7.13	5.18	3.63	6.34
P11	0.81	0.86	0.81	0.72	0.84
Increasing *RP*					
Constant	0.22**	0.33***	0.31***	0.07	0.28**
L1.Predictor	0.44**	−0.22	0.81**	−0.35	−0.01
L2.Predictor	−0.30	0.45**	−0.27	−0.92	0.001
Sigma	0.31	0.28	0.26	0.41	0.33
Duration	4.26	3.59	2.92	12.46	3.77
P22	0.77	0.72	0.66	0.92	0.73

Notes: This table presents the Markov-switching regression (autoregression) for the first difference of RP_{RERC} over the period of 1994:Q2 to 2015:Q4 ($N = 87$) and individual fundamentals. RP_{RERC} is the expected (ex ante) risk premium based on the expected IRR of investors surveyed by RERC/Situs RERC and the risk-free rate. ϕ_p captures the autoregressive components *for* RP_{RERC}, which is AR(2). *SPR* is the credit risk spread defined as difference in yields between BAA- and AAA-rated corporate bonds. *TERM* is the term structure based on the difference in yields between 10-yr Treasury bonds and 3-month Treasury bills. NTBI is the total return on the NCREIF transaction-based index. *NAREIT* is the total return on the NAREIT equity index. *UNEMP* is the quarterly US unemployment rate. All variables are in first differences.

* Statistically significant at the 10% level.

** Statistically significant at the 5% level.

*** Statistically significant at the 1% level.

debt capital market conditions on the risk premium is in line with the findings of previous studies (Chichernea et al., 2008; Plazzi, Torous, and Valkanov, 2008; Chervachidze, Costello, and Wheaton, 2009; Clayton, Ling, and Naranjo, 2009; Chervachidze and Wheaton, 2013), our results suggest that this effect is not linear. Rather, changes in debt capital market conditions further increase the ex ante risk premium when investor risk perception is increasing. We also find that changes in unemployment have a statistically significant relation with the ex ante risk premium in both states. However, during times of a decreasing risk premium, the relation between changes in unemployment and changes in the risk premium transition from the expected positive direction in the second lag to a negative direction in the first lag. This suggests that during robust economic conditions, changes in unemployment have a negligible effect on the risk premium. On the other hand, when there is an increasing risk premium, the relation is in the

expected positive direction. When unemployment increases (decreases), the ex ante risk premium increases (decreases). Commercial real estate market conditions as measured by the total return on the NTBI display a statistically significant negative relation with the ex ante risk premium when there is a decreasing risk premium (first lag). Thus, an increase (decrease) in commercial real estate returns decreases (increases) the ex ante risk premium. Our results in Exhibit 7 suggest that the results for *FUND* in Exhibit 6 are driven by debt capital market conditions (*SPR and TERM*) and economic conditions (*UNEMP*). Overall, our findings indicate that debt capital market conditions have predictive power for the ex ante risk premium when there is an increasing risk premium, while commercial real estate market performance has predictive power when there is a decreasing risk premium.

REIT market conditions do not appear to have predictive power for the ex ante risk premium required by commercial real estate market investors. This result is surprising given the informational value of public real estate market information for the private real estate market (Giliberto, 1990; Barkham and Geltner, 1995; Oikarinen, Hoesli, and Serrano 2011; Yunus, Hansz, and Kennedy, 2012). One explanation for our finding is that we use an aggregated ex ante risk premium measure. To further investigate the relation between the *NAREIT* return and the commercial real estate market risk premium, we conduct a Markov-switching regression for each property type, using property type-specific ex ante risk premiums and *NAREIT* returns. The results in Exhibit 8 suggest that for office and apartment, changes in *NAREIT* returns have a negative relation (first and second lags) with changes in the risk premium when there is a decreasing risk premium. Thus, an increase (decrease) in *NAREIT* returns decreases (increases) the ex ante risk premium required by commercial real estate investors. REIT market conditions have no predictive power for industrial real estate. For retail real estate, changes in *NAREIT* returns have a statistically significant negative relation (first lag) with changes in the ex ante risk premium when there is an increasing risk premium. Our result for retail emphasizes the difference in the ex ante retail risk premium from other property type risk premiums as the results in Exhibit 6 suggest. The predictive power of the fundamental variables for different states of the retail risk premium is opposite to that of the other property types. The results in Exhibit 8 also suggest that our results for *NAREIT* in Exhibit 7 are a result of the aggregation of different property type risk premiums into an aggregated risk premium measure. They also imply that the predictive power of the REIT market returns on the ex ante risk premium varies by property type and the state of investor risk perception.

Exhibit 9 presents the results for changes in stock market volatility (*VIX*) and the RERC/Situs RERC-based risk premium. Changes in *VIX* have a consistently positive relation with changes in the ex ante risk premium required by commercial real estate investors. An increase (decrease) in the expected stock market volatility (i.e., the fear index), leads to increases (decreases) in the ex ante real estate risk premium. However, stock market volatility has more predictive power in terms of

Exhibit 8 | Markov-Switching Regression Results: RP_{RERC} and NAREIT

	Office	Industrial	Retail	Apartment
Decreasing *RP*				
ϕ_p	−0.24***	−0.40***	−0.50***	−0.40***
Constant	−0.22***	−0.12**	−0.13**	−0.21***
L1.NAREIT	−0.05***	0.00	−0.01	−0.05***
L2.NAREIT	−0.06***	−0.004	0.004	−0.03**
Sigma	0.12	0.33	0.33	0.22
Duration	3.01	8.08	7.31	5.19
P11	0.67	0.88	0.86	0.81
Increasing *RP*				
Constant	0.09	0.37***	0.39***	0.14**
L1.NAREIT	−0.01	−0.03	−0.05**	−0.01
L2.NAREIT	0.001	−0.01	−0.03	−0.01
Sigma	0.45	0.29	0.32	0.40
Duration	8.39	3.33	3.11	8.44
P22	0.88	0.70	0.68	0.88

Notes: This table presents the Markov-switching regression (autoregression) for the first difference of RP_{RERC} over the period of 1994:Q2 to 2015:Q4 ($N = 87$) *and* NAREIT returns. RP_{RERC} is the expected (ex ante) risk premium based on the expected IRR of investors surveyed by RERC / Situs RERC and the risk-free rate. ϕ_p captures the autoregressive components for RP_{RERC}, which is AR(2). *NAREIT* is the total return on the NAREIT equity index. *UNEMP* is the quarterly U.S. unemployment rate. All variables are in first differences.

* Statistically significant at the 10% level.

** Statistically significant at the 5% level.

*** Statistically significant at the 1% level.

significant lags and total effect size in times of a decreasing risk premium. Our findings for *VIX* are robust across property types.

Our results for commercial real estate sentiment are provided in Exhibit 10. For the aggregated or overall sentiment measure (All column), changes in commercial real estate sentiment have a statistically significant negative relation (first and second lags) with changes in the ex ante risk premium when there is a decreasing risk premium. Thus, during these periods, an increase (decrease) in commercial real estate sentiment leads to a decrease (increase) in the ex ante risk premium. In other words, as the optimism of commercial real estate investors increases, it lowers their ex ante risk premium. Based on the aggregated measure, investor sentiment exhibits no discernable impact on the aggregate risk premium when there is an increasing risk premium.

For the disaggregated analysis, we use our property type-specific sentiment measures. The results for office in Exhibit 10 are in line with the aggregate sentiment measure. For industrial, commercial real estate sentiment has predictive

Exhibit 9 | Markov-Switching Regression Results: RP_{RERC} and VIX

	All	Office	Industrial	Retail	Apartment
Decreasing *RP*					
ϕ_p	0.03	−0.07	−0.07	0.16*	−0.12
Constant	−0.39***	−0.14*	−0.21	−0.04	−0.18
L1.VIX	0.06***	0.04***	0.04***	0.03***	0.04***
L2.VIX	0.02***	0.002	0.01	0.01	0.02
L3.VIX	0.02***	0.02*	0.04**	0.02**	0.02
Sigma	0.03	0.32	0.33	0.23	0.32
Duration	1.08	3.76	1.17	1.00	1.77
P11	0.07	0.73	0.15	0.01	0.43
Increasing *RP*					
Constant	0.07	0.31**	0.13	0.08	0.15
L1.VIX	0.02***	0.02*	0.02**	0.05**	0.02*
L2.VIX	−0.01	−0.03	−0.01	−0.01	−0.01
L3.VIX	0.002	0.01	0.002	−0.02	−0.01
Sigma	0.35	0.32	0.33	0.48	0.35
Duration	7.43	1.76	2.09	1.11	2.09
P22	0.87	0.43	0.52	0.10	0.52

Notes: This table presents the Markov-switching regression (autoregression) for the first difference of RP_{RERC} over the period of 1994:Q3 to 2015:Q4 ($N = 86$) and stock market volatility. RP_{RERC} is the expected (ex ante) risk premium based on the expected IRR of investors surveyed by RERC/Situs RERC and the risk-free rate. ϕ_p captures the autoregressive components for RP_{RERC}, which is AR(2). Stock market volatility is measured as the implied stock market volatility (S&P 500) based on the Chicago Board Options Exchange (CBOE) volatility index (VIX). All variables are in first differences.

*Statistically significant at the 10% level.

**Statistically significant at the 5% level.

***Statistically significant at the 1% level.

power in both states of the risk premium. While the overall effect of changes in sentiment on changes in the risk premium is larger when there is a decreasing risk premium based on coefficient sizes, changes in sentiment allow us to predict changes in the risk premium sooner (i.e., three quarters prior) when there is an increasing risk premium. On the other hand, for retail and apartment, commercial real estate sentiment exerts no detectable predictive power for the ex ante risk premium when there is a decreasing risk premium. Instead, changes in $SENT_{RE}$ have a statistically significant negative relation (three lags for industrial and one for apartment) with changes in the ex ante risk premium when there is an increasing risk premium. Overall, our findings for $SENT_{RE}$ suggest that the predictive power of commercial real estate sentiment for the ex ante risk premium is asymmetric across states of investor risk perception and differs by property type. For retail and apartment investors, commercial real estate sentiment affects

Exhibit 10 | Markov-Switching Regression Results: RP_{RERC} and $SENT_{RE}$

	ALL	Office	Industrial	Retail	Apartment
Decreasing *RP*					
ϕ_p	−0.34**	−0.65***	−0.22**	−0.40***	−0.08
Constant	−0.09	−0.11***	−0.14***	−0.22***	−0.03
$L1.SENT_{RE}$	−0.33***	−0.57***	−0.33***	0.12	−0.04
$L2.SENT_{RE}$	−0.29***	−0.60***	−0.27***	−0.07	0.07
$L3.SENT_{RE}$	0.01	−0.004	−0.001	0.03	0.04
Sigma	0.34	0.35	0.12	0.33	0.38
Duration	9.29	6.59	5.29	4.57	52.25
P11	0.89	0.85	0.81	0.78	0.98
Increasing *RP*					
Constant	0.09	0.20***	0.06	0.21***	0.28
$L1.SENT_{RE}$	0.13	0.14	−0.04	−0.18***	−0.70*
$L2.SENT_{RE}$	−0.02	0.08	−0.17**	−0.17**	−0.32
$L3.SENT_{RE}$	−0.16	0.04	−0.15*	−0.14*	0.39
Sigma	0.31	0.19	0.42	0.33	0.38
Duration	7.34	3.88	22.32	4.49	5.45
P22	0.86	0.74	0.96	0.78	0.82

Notes: This table presents the Markov-switching regression (autoregression) for the first difference of RP_{RERC} over the period of 1994:Q3 to 2015:Q4 ($N = 86$) and commercial real estate investor sentiment. RP_{RERC} is the expected (ex ante) risk premium based on the expected IRR of investors surveyed by RERC / Situs RERC and the risk-free rate. ϕ_p captures the autoregressive components for RP_{RERC}, which is AR(2). Real estate market sentiment is based on investment conditions perceived by investors (RERC / Situs RERC survey). All variables are in first differences.

* Statistically significant at the 10% level.

** Statistically significant at the 5% level.

*** Statistically significant at the 1% level.

their risk assessment and pricing when there is an increasing risk premium, while for office, sentiment has an impact on the ex ante risk premium when there is a decreasing risk premium. Our results suggest that the results for the overall sentiment in Exhibit 10 are mostly driven by the office and industrial property types.

Overall, our results show that real estate market sentiment explains the variation in the ex ante risk premium, albeit asymmetrically. Our findings for the predictive power of commercial real estate sentiment for the risk premium are in line with those of Clayton (1996) and Clayton, Ling, and Naranjo (2009). They also further emphasize the informative value of sentiment to real estate investors (Ling, Naranjo and Scheick, 2014; Marcato and Nanda, 2016; Freybote and Seagraves, 2017).

Exhibit 11 | Markov-Switching Regression Results: RP_{NCREIF} and Overall Economic Conditions

	All	Office	Industrial	Retail	Apartment
Decreasing *RP*					
ϕ_p	−0.07	−0.03	0.02	−0.47***	−0.18
Constant	−0.14***	−0.10*	−0.35***	−0.002***	−0.20***
L1.FUND	0.25***	0.25***	0.02	0.33***	0.28***
L2.FUND	0.06	−0.03	−0.03	−0.06	0.14**
L3.FUND	0.08	0.11	0.15**	0.04	−0.20
Sigma	0.17	0.32	0.15	0.25	0.17
Duration	3.16	2.09	1.50	1.87	2.37
P11	0.68	0.52	0.33	0.46	0.58
Increasing *RP*					
Constant	0.11	0.03	0.08**	0.24***	0.12***
L1.FUND	−0.04	0.01	0.10**	−0.22	−0.14**
L2.FUND	0.02	0.10***	0.04	−0.10	−0.06
L3.FUND	0.004	−0.06	0.03	0.13	0.02
Sigma	0.30	0.15	0.18	0.25	0.17
Duration	3.79	1.10	4.52	1.43	2.99
P22	0.74	0.09	0.78	0.30	0.67

Notes: This table presents the Markov-switching regression (autoregression) for the first difference of RP_{RERC} over the period of 1994:Q3 to 2015:Q4 ($N = 86$) and a fundamental factor. RP_{NCREIF} is the expected (ex ante) risk premium based on the income return on the overall NCREIF index (cap rates) plus expected 10-year inflation and the risk-free rate. ϕ_p captures the autoregressive components for RP_{RERC}, which is AR(2). Fundamentals represents the first principal component with the largest Eigenvalue of the following fundamental variables: credit risk spread defined as difference in yields between BAA- and AAA-rated corporate bonds; term structure based on the difference in yields between 10-yr Treasury bonds and 3-month Treasury bills; total return on the NCREIF transaction-based index (NTBI), total return on the NAREIT equity index, and the quarterly U.S. unemployment rate. All variables are in first differences.

*Statistically significant at the 10% level.

**Statistically significant at the 5% level.

***Statistically significant at the 1% level.

As shown in Exhibits 6, 8, and 10, the impact of changes in economic conditions (*FUND*), *NAREIT* returns, and sentiment across different states of risk perception differs for retail real estate compared to other property types. Unfortunately, our dataset does not allow us to further separate the return required by retail real estate investors into the required return for different types of retail investors (e.g., neighborhood shopping centers, power centers or regional malls). A more detailed analysis within the diverse retail real estate category may provide further insights into the impact of investor and asset characteristics on our findings. Additionally, to our knowledge, there are no studies that investigate the differences in risk perception or return requirements among commercial real estate investors

Exhibit 12 | Markov-Switching Regression Results: RP_{NCREIF} and $SENT_{RE}$

	All	Office	Industrial	Retail	Apartment
Decreasing *RP*					
ϕ_P	0.15	0.30**	−0.18	−0.33***	−0.34***
Constant	−0.08	−0.41***	−0.14***	−0.34***	−0.25***
$L1.SENT_{RE}$	−0.11*	−0.37***	−0.23***	−0.14***	−0.20***
$L2.SENT_{RE}$	−0.14***	−0.07	−0.33***	−0.31***	0.09
$L3.SENT_{RE}$	−0.09	−0.39***	−0.13	−0.21***	0.03
Sigma	0.23	0.12	0.17	0.12	0.18
Duration	8.54	1.02	3.55	1.00	2.86
P11	0.88	0.02	0.64	0.01	0.65
Increasing *RP*					
Constant	0.16	0.07	0.07**	0.11***	0.18***
$L1.SENT_{RE}$	0.06	−0.08	0.17***	0.08*	−0.06
$L2.SENT_{RE}$	−0.05	−0.14**	0.05	0.07	−0.01
$L3.SENT_{RE}$	−0.28**	−0.22***	−0.09*	−0.08*	−0.07
Sigma	0.25	0.27	0.17	0.29	0.13
Duration	5.85	4.66	5.21	3.82	3.31
P22	0.83	0.79	0.81	0.74	0.70

Notes: This table presents the Markov-switching regression (autoregression) for the first difference of RP_{RERC} over the period of 1994:Q3 to 2015:Q4 ($N = 86$) and real estate market sentiment. RP_{NCREIF} is the expected (ex ante) risk premium based on the income return on the overall NCREIF index (cap rates) plus expected 10-year inflation and the risk-free rate. ϕ_p captures the autoregressive components for RP_{RERC}, which is AR(2). Real estate market sentiment is based on investment conditions perceived by investors (RERC survey / Situs RERC). All variables are in first differences.

* Statistically significant at the 10% level.

** Statistically significant at the 5% level.

*** Statistically significant at the 1% level.

specializing in different property types that could help us explain our findings theoretically. We encourage future investigations into the risk perception and return determination of different types of real estate investors, based on investor, property type, and locational characteristics.

Our results in Exhibits 6–10 focus on the RERC/Situs RERC survey-based ex ante risk premium. In the remainder of this section, we focus on the NCREIF-based ex ante risk premium. Exhibit 11 presents the results for the relation between the changes in the fundamental factor (*FUND*) and the NCREIF-based risk premium. While the coefficients and significant lags differ between the aggregated and disaggregated risk premiums, changes in the fundamental factor have a larger impact on changes in the ex ante risk premium when the risk premium is decreasing. This differs from our results for the RERC/Situs RERC survey-based risk premium in Exhibit 6, where the changes in the fundamental

factor predominantly have predictive power for the risk premium when the risk premium is increasing. One explanation for this difference is that RP_{NCREIF} is based on the income return on the appraisal-based NPI and an approximation for capital appreciation.

The varying impact of the fundamental factors on the RP_{RERC} and RP_{NCREIF} over different states may explain the varying pairwise correlations for these two variables in Exhibit 3. Interestingly, changes in *FUND* have a negative relation with changes in the apartment risk premium when the risk premium is increasing. One explanation is that as fundamental conditions deteriorate, apartment investors may reduce their required risk premium as the affordability of single-family homes decreases, the demand for apartments likely increases.

Our results for stock market volatility (*VIX*) and the NCREIF-based risk premium (not reported) are in line with Exhibit 9. Changes in stock market volatility exhibit predictive power for changes in the real estate risk premium in times of decreasing risk premium. Lastly, Exhibit 12 presents the results for the relation between real estate market sentiment ($SENT_{RE}$) and RP_{NCREIF}. Analogously to the RP_{RERC} results in Exhibit 10, changes in investor sentiment have more predictive power for changes in the risk premium when there is a decreasing risk premium. However, compared to the survey-based risk premium results in Exhibit 10, changes in commercial real estate sentiment have an impact on changes in the risk premium in the increasing risk premium state for the aggregate and office risk premiums and in the decreasing risk premium state for the apartment and retail risk premiums. Our results in Exhibits 10 and 12 suggest that commercial real estate sentiment has the least explanatory power for the apartment risk premium.

Conclusion

When assessing investment risks and determining their required returns, commercial real estate investors rarely have access to all decision-relevant information. We investigate the sources of information these investors are likely to use in determining their ex ante risk premium. We find that changes in the ex ante risk premium that investors require, based on what they report in a survey, are driven by changes in fundamental factors, such as debt capital market conditions and unemployment, as well as NAREIT and NCREIF returns. Additionally, stock market volatility and commercial real estate investor sentiment have predictive power for the ex ante risk premium.

However, our findings suggest that the impact of various fundamental and non-fundamental determinants differs across different ex ante risk premium regimes. Changes in stock market volatility and commercial real estate market returns generally appear to have more predictive power for changes in the ex ante risk premium when there is a decreasing risk premium (risk perception). On the other hand, changes in debt capital market conditions have more predictive power when there is an increasing risk premium (risk perception). The predictive power of

changes in commercial real estate sentiment and NAREIT returns for changes in the risk premium depends on the property type and risk premium states. While our findings for the NCREIF-based risk premium are similar to those for the RERC/Situs RERC survey-based risk premium, they nevertheless suggest that these two ex ante risk premiums differ to some degree and the predictive power of investigated factors varies between ex ante risk premium definitions.

In addition, our results demonstrate the advantages of the non-linear Markov-switching regression compared to the linear VAR, separated by periods, to investigate non-linear relationships. Our results suggest that a variety of information sources affect the ex ante risk premium that commercial real estate investors require. However, the importance of different sources of fundamental and non-fundamental information varies across different states (i.e., is asymmetric), and may be driven by differences in investor risk perception or information availability.

Future investigations could focus on investor- or location-specific drivers of ex ante risk premiums. Cypher, Price, Robinson, and Seiler (2018) find that commercial real estate investors rely to a larger degree on private signals from a trusted broker than market information when making pricing decisions. Future studies may not only investigate the impact of investor characteristics on the ex ante risk premium, but also the impact of brokers or other private sources of information. Moreover, in the stock market, perception of risk and return by investors affects trading behavior and risk taking (Hoffman, Post, and Pennings, 2015). The risk dynamics in commercial real estate markets are relatively under-researched (Plazzi, Torous, and Valkanov, 2008). Therefore, future studies could investigate the risk perception of commercial real estate investors in more detail and identify additional factors driving pricing decisions, as well as factors that impact the commercial real estate investor's risk taking and trading behavior.

Endnotes

[1] This correlation value is calculated between the average 10-year inflation expectations and the following 10-year NCREIF price appreciation.

[2] In comparison to the NCREIF Property Index (NPI), which is a value-weighted index based on appraised values of index properties, the NCREIF transaction-based index (NTBI) is equally-weighted and takes transactions of index properties into account. For more information, please visit: https://www.ncreif.org/data-products/tbi/.

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