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Commercial Real Estate Valuation: Fundamentals Versus Investor Sentiment

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Abstract This paper investigates the role of fundamentals and investor sentiment in commercial real estate valuation. In real estate markets, heterogeneous properties trade in illiquid, highly segmented and informationally inefficient local markets. Moreover, the inability to short sell private real estate restricts the ability of sophisticated traders to enter the market and eliminate mispricing. These characteristics would seem to render private real estate markets highly susceptible to sentiment-induced mispricing. Using error correction models to carefully model potential lags in the adjustment process, this paper extends previous work on cap rate dynamics by examining the extent to which fundamentals and investor sentiment help to explain the time-series variation in national-level cap rates. We find evidence that investor sentiment impacts pricing, even after controlling for changes in expected rental growth, equity risk premiums, T-bond yields, and lagged adjustments from long run equilibrium.

Keywords Investment · Capitalization rates · Asset pricing · Investor rationality

Introduction

Classical finance theory posits that prices of assets traded in relatively frictionless markets reflect rationally estimated risk-adjusted discount rates and future income

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streams; there is no role for investor sentiment. If mispricing does occur, it is quickly eliminated by the actions of informed arbitrageurs who compete to capture the abnormal returns. The inability of the standard present value model to explain dramatic run-ups and subsequent crashes in asset prices, such as the internet stock "bubble" in the late 1990s and other price anomalies, has led to the development of the "behavioral" finance approach to asset valuation. In these behavior models, investor sentiment can have a role in the determination of asset prices—independent of market fundamentals.

The behavioral approach explicitly recognizes that some investors are not rational and that systematic biases in these investor's beliefs induce them to trade on non-fundamental information (i.e., sentiment). Baker and Wurgler (2007) define investor sentiment as a misguided belief about the growth in future cash flows or investment risks (or both) based on the current information set. The behavioral approach is also predicated on "limits to arbitrage." Arbitrageurs face non-trivial transaction and implementation costs that prevent them from taking fully offsetting positions to correct mispricing. In addition, rational risk-averse investors are unable to arbitrage away the mispricing because the unpredictability of investor sentiment exposes them to "noise trader risk" (DeLong et al. 1990). Hence, to the extent that sentiment influences valuation, taking a position opposite to prevailing market sentiment can be both expensive and risky. It is therefore important to understand the relative influence of fundamentals versus sentiment in asset valuation.

Private commercial real estate markets are characterized by higher transaction costs and substantially less liquidity than public stock markets. Thus, if relatively small frictions in the stock market can cause sustained periods of overvaluation, it seems plausible to posit that private real estate markets are potentially more susceptible to such episodes. The inability to short sell private real estate restricts the opportunity for sophisticated traders to enter the market and eliminate mispricing, especially if they believe the property market is overvalued. Limits to arbitrage might therefore be expected to lead to larger deviations of prices from fundamental value in the presence of sentiment investors.

Despite the potential importance of investor sentiment in private real estate markets, no previous research directly investigates the relative roles of fundamentals and investor sentiment in the pricing and return generation process.[1] This paper examines the relative influence of fundamentals and investor sentiment in explaining the time-series variation in property-specific national-level capitalization rates.

Our specific innovations are twofold. First, we apply a new dataset to the study of cap rate determinants that includes fundamental variables and both survey (direct) measures of investor sentiment and composite (indirect) measures of investor sentiment constructed from a set of sentiment proxies. Second, the nature of our data allows us to utilize an innovative econometric approach to the analysis of the relation between sentiment and property pricing. More specifically, we derive an equilibrium model of cap rates specified as a function of real estate space and capital market fundamentals that is estimated using error-correction techniques, thereby

[1] Hendershott and MacGregor (2005a, b) test whether cap rates, and hence property values, reflect rational projections of future rental growth and expected returns, thereby providing an indirect test of the role of sentiment.

capturing both short and long-run pricing dynamics. The primary contribution of the paper is the exploration of the impact of time-varying fundamentals and investor sentiment on property pricing. To summarize our findings, we find evidence that investor sentiment significantly impacts pricing, even after controlling for changes in expected rental growth, equity risk premiums, T-bond yields, and lagged adjustments from long run equilibrium.

The remainder of the paper proceeds as follows. "Background and Previous Literature" discusses the relevant literature, including key insights from sentiment-based theories of stock pricing as well as previous empirical studies of the determinants of variations in real estate cap rates. In "Modeling Prices and Cap Rates", "The Dynamic Nature of Real Estate Pricing and Cap Rates", and "Empirical Specification" we present our conceptual and empirical models of cap rates. Section "Data" discusses the data. "Results" and "A Vector Error-Correction Model" contain our empirical findings and robustness checks. We conclude with a summary.

Background and Previous Literature

Both sentiment and limits to arbitrage are necessary conditions for the existence of mispricing. More specifically, in a market characterized by heterogeneous investors, the existence of short sale constraints can generate deviations in asset prices from fundamental values. Optimistic investors take long positions, while pessimistic investors would like to take short positions. Short-sale constraints, however, may inhibit the ability of rational investors to eliminate overpricing, even over sustained time periods. Therefore, rational investors may sit on the sidelines when they believe prices are too high relative to fundamentals, leaving market clearing prices to be determined, at the margin, by overly optimistic investors as in Baker and Stein (2004).

Most behavioral finance research has followed a "bottom up" microeconomic approach that appeals to biases in individual investor psychology to explain how and why investors might overreact or under-react to past returns and information about market fundamentals.[2] Brown and Cliff (2004, 2005) and Baker and Wurgler (2006, 2007) offer a new "top down" macroeconomic approach, the first step of which is to derive measures of aggregate investor sentiment for stocks. Brown and Cliff (2004, 2005) employ both survey measures of investor sentiment as well as sentiment measures derived from a principal component analysis of a set of potential sentiment proxies. They find that investor sentiment is highly correlated with contemporaneous stock returns but has little short-run predictive power (Brown and Cliff 2004). However, taking a longer term perspective (2 to 3 years), periods of high sentiment are followed by low returns as the market mean reverts (Brown and Cliff 2005).

Baker and Wurgler (2006, 2007) also employ principal component analysis to construct a sentiment measure, and they extend the literature by quantifying the differential effect of sentiment on the cross-section of stock returns by identifying which stocks are likely to be more affected by sentiment. Consistent with model

[2] Hirshleifer (2001) and Barberis and Thaler (2003) provide reviews of the extensive behavioral finance literature.

predictions, their results suggest that when beginning-of-period proxies for investor sentiment are high (low), subsequent returns are relatively low (high) for stocks that are either more speculative in nature or for which arbitrage tends to be particularly risky.

Real estate investors monitor market sentiment in several ways. First, they may subscribe to data services that provide regular survey-based information about investment sentiment (such as the quarterly RERC *Real Estate Report* used in this paper). Many investors also monitor variables related to "capital flows" into the real estate sector. For example, they may track data on mortgage flows, the dollar volume and number of properties sold, and capital flowing into real estate investment vehicles (e.g., commingled funds for institutional and high net worth investors) under the belief that there is a common sentiment component embedded in these investor activity variables.[3]

Although regarded as important by practitioners, there has been relatively little academic work aimed at understanding the role of fundamentals versus investor sentiment and capital flows in real estate pricing dynamics. A contemporaneous correlation between capital flows and cap rates does not by itself imply causation. Capital flows and property prices (and hence cap rates) might both respond in a similar fashion to fundamental economic variables and risk factors, such as unexpected inflation, changes in real interest rates, or revisions in risk premiums. For example, if both capital flows and property prices increase when positive economic news is released, then a negative contemporaneous correlation between capital flows and cap rates does not prove that capital flows cause or predict cap rates.

The lack of research examining the role of fundamentals versus sentiment and capital flows in real estate markets is partly due to data limitations. Ling and Naranjo (2003, 2006) examine the dynamics of commercial real estate capital flows and returns. Their work provides evidence that capital flows into public (i.e., securitized) real estate markets do not predict subsequent returns, but that returns do affect subsequent capital flows into these securitized real estate markets. Fisher et al. (2007) extend the work of Ling and Naranjo (2003, 2006) by investigating the short- and long-run dynamics among institutional capital flows and property returns in the largest US metropolitan areas. The authors find some evidence that lagged institutional capital flows influence current returns at the aggregate level, but the evidence is less convincing when disaggregated by metropolitan area and property type. These papers provide useful empirical characterizations of the dynamics of real estate capital flows and pricing, and therefore provide a solid foundation on which additional research can build. However, their results do not directly address the role sentiment plays in real estate markets, as they do not explicitly relate capital flows to investor sentiment within a model of property pricing.

[3] As part of the growing behavioral finance literature, researchers have also begun to carefully explore the impact of "flows" and trading activity on asset prices in public markets. See, for example, Warther (1995), Edelen and Warner (2001), Froot et al. (2001), Brown et al. (2002), Griffin et al. (2007), and Fama and French (2007). Clayton (2003) reviews much of this literature with a focus on the implications for private real estate.

Shilling and Sing (2007) examine the rationality of investors' expected income growth rates and total return forecasts in private commercial real estate markets. Their findings are consistent with models of investor irrationality. Furthermore, Shilling and Sing find evidence that investors act overly optimistic and that they generally anchor their expectations to the previous period. Finally, Ling (2005) provides preliminary univariate evidence consistent with real estate pricing being driven at times by investor sentiment.[4]

Modeling Prices and Cap Rates

Archer and Ling (1997) argue that three "markets" play a role in determining commercial real estate prices: space markets, capital markets, and property markets. Local market rents are determined in the space market (i.e., the market for leasable space). Required risk premiums for assets with varying profiles of cash flow risk are determined in the capital market. Finally, property markets are where asset-specific discount rates, property values, and cap rates are determined.

Property-specific discount rates are determined by the interaction of the risk-free rate, investor risk premiums, and the risk profile of the specific property. For a given stream of expected net operating income (NOI), the equilibrium property price at time t, P_t^e, should equal the present value of the NOIs discounted at the assumed constant unlevered risk-adjusted rate, r_t. That is,

$$P_t^e = \frac{NOI_1}{(1+r_t)} + \frac{NOI_1(1+g_{t=2})}{(1+r_t)^2} + \frac{NOI_3(1+g_{t=3})}{(1+r_t)^3} + \dots + \frac{NOI_{T-1}(1+g_{t=T}) + NSP_T}{(1+r_t)^T}, \quad (1)$$

where T is the expected holding period in years and NSP_T is the expected net sale proceeds in year T.[5] It is well known (e.g., Geltner et al. 2007, pp. 209–210) that if, at time t, NOI is expected to grow at a constant rate g_t, and NSP is expected to remain a constant multiple of NOI, then Eq. 1 simplifies to a valuation formula in which P_t^e is solely a function of the expected growth in NOI and the property specific risk-adjusted discount rate. That is,

$$P_t^e = \frac{NOI_1}{r_t - g_t} = \frac{NOI_1}{R_t^e} \quad or \quad \frac{P_t^e}{NOI_1} = \frac{1}{r_t - g_t} \quad (2)$$

Note that property values can be expressed as a multiple of first-year NOI and the size of the multiple is a function of (1) the property-specific discount rate, and (2)

[4] Gompers and Lerner (2000) study the relationship between flow of funds (commitments) into venture capital funds and the valuation of new investments (firms) financed by the venture capital funds. Their findings are consistent with an uninformed demand /sentiment explanation of the link between fund flows and valuations.

[5] NOI is assumed to include a reserve for expected capital expenditures and other nonrecurring expenses, such as leasing commissions.

expected changes in NOI.[6] The equilibrium cap rate at time t, R_t^e, is merely the reciprocal of the value multiple. From Eq. 2, it follows that:

$$R_t^e = r_t - g_t, \tag{3}$$

It is important to note that the *level* of NOI has no impact on the cap rate. Rather, it is the excepted *change* in NOI that affects the price investors are willing to pay per dollar of first year NOI. Of course, it is unlikely that NOI growth rates and future discount rates are expected to be constant forever. Nevertheless, Eq. 3 is an approximation that motivates our empirical cap rate specification and is consistent with a more general present value model that allows for time-variation in NOI growth and the discount rate to impact commercial property valuation and hence the cap rate.[7]

The risk-adjusted discount rate has two components: RF_t, the rate of return available on a risk-free. Treasury bond with a maturity equal to the expected holding period of the property; and RP_t, the required risk premium, which is property, market, and time dependent. Clearly, RF_t, is determined outside local space and property markets, as yields on Treasury securities are determined by the bid and ask prices of Treasury market investors from around the world.

What about the determinants of RP_t? In the capital markets, commercial real estate competes with all other assets for a place in investors' portfolios. According to classical portfolio theory, investors will select a mix of investments based on the variances and covariances of the returns among the possible assets. As investors bid for their optimal portfolio mix, their bidding simultaneously determines the required risk premiums for the universe of investments according to their risk (variance and covariance) profiles. Thus, the pricing of risk depends on risk preferences articulated in the broader capital as well as the specific risk profile of the investment, which is determined by current and expected future conditions in the space market in which the property is located.

The Dynamic Nature of Real Estate Pricing and Cap Rates

In highly liquid public securities markets, asset prices are believed to adjust quickly to changes in market fundamentals such as interest rates, inflation expectations, and national and local market conditions. However, in private, commercial real estate markets, observed cap rates may adjust more gradually to the arrival of new information because of numerous property market inefficiencies, such as high transaction costs, lengthy decision making processes and due-diligence periods, and informational inefficiencies. A number of authors have estimated structural models derived from theoretical cap rate models to investigate property price dynamics

[6] State and federal income tax effects also affect property values and, therefore, price/NOI multiples, as may the amount and cost of mortgage financing.

[7] Geltner and Mei (1995) and Plazzi et al. (2004) both adapt variants of Campbell and Shiller's (1998) log-linearized present value model with time-varying discount and "dividend" growth rates to study the relative contributions of time-variation in expected future returns versus property income in property valuation. Both studies conclude that in the short run, property price fluctuations are driven primarily by changes in expected returns and not expected rents.

(Sivitanides et al. 2001; Hendershott and MacGregor 2005a, b; Chen et al. 2004; Plazzi et al. 2004, Chichernea et al. 2008; Sivitanidou and Sivitanides 1999).

To capture both long-run and short-run cap rate dynamics, we employ an error correction model (ECM) similar to Hendershott and MacGregor (2005a). This framework allows us to model cap rates as an adjustment process around equilibrium values. Error correction models are based on the idea that two or more time series exhibit a long-run time-varying equilibrium to which the system tends to converge. The long-run influence in the error correction model is achieved through negative feedback and error correction, and this influence measures the degree to which long-run equilibrium forces drive short-run price dynamics (see, for example, Engle and Granger 1987 and Hamilton 1994).

Following the Engle-Granger two-step method, a long-run cap rate model is specified in levels. The second-stage, short-run, adjustment model is specified in first differences and includes a long-run error correction term from the estimation of the long-run (equilibrium) model. In the first-stage, theory and econometric evidence are used to determine if the various data series contain unit roots and are cointegrated. If the data series are cointegrated, a long-run equilibrium relation (i.e., a cointegrating regression) can be specified in levels as:

$$R_t = \beta_0 + \sum_{i=1}^{n} \beta_i X_{it} + \upsilon_t \;, \tag{4}$$

where R_t is the observed cap rate and X_{it} are theoretically-based explanatory variables at time t. From this regression, we can estimate residuals as the difference between the actual and estimated equilibrium values of the cap rate.[8] If the residuals from Eq. 4 are stationary, they may be used as an error correction term in the short-run cap rate change model as follows:

$$\Delta R_t = \alpha_0 + \sum_{i=1}^{n} \alpha_i \Delta X_{it} - \gamma \hat{\upsilon}_{t-1} + \varepsilon_t, \tag{5}$$

where $\Delta R_t = R_t - R_{t-1}$ is the first difference of the cap rate, ΔX_{it} are first differences of the explanatory variables, and $\hat{\upsilon}_{t-1}$ is the error correction term (the lagged residuals from the long-run regression). Estimation of Eq. 5 provides evidence on short-run cap rate dynamics (the α_i's) and adjustments to the previous disequilibrium in the long-run relation, γ (the speed of adjustment parameter). If $\gamma = 1$, there is full adjustment, while $\gamma = 0$ suggests no adjustment. A more general specification of the short-run model may also include multiple lags of the explanatory and dependent variables.

[8] The specification in Eq. 4 uses the results of Eq. 3 to specify the equilibrium cap rate as a function of the discount rate, r_t, and expected NOI growth, g_t, but does not impose the exact relationship, $R_t = r_t - g_t$, that holds under the constant growth assumption.

Empirical Specification

Based on our earlier theoretical discussion of equilibrium factors influencing cap rates, we employ the following empirical model to each of the nine property types (see property type discussion in the next section). In the first-stage, we estimate:

$$R_t = \beta_0 + \beta_1 NOIGRW_t + \beta_2 RP_t + \beta_3 RF_t + \upsilon_t, \tag{6}$$

where $NOIGRW_t$ is the expected growth in NOI, RP_t is the unlevered equity risk premium, and RF_t is the yield-to-maturity on a 10-year Treasury security. In the second-stage, we estimate the following short-run error correction model for each of the nine property types:

$$\Delta R_t = \alpha_0 + \alpha_1 \Delta NOIGRW_t + \alpha_2 \Delta RP_t + \alpha_3 \Delta RF_t + \gamma \hat{\upsilon}_{t-1}. \tag{7}$$

Equation 6 postulates that equilibrium cap rate levels are driven by two sets of influences: (1) discount rate influences that reflect the risk-free opportunity cost of equity capital and the equity risk premium and (2) factors that influence the *NOI* growth expectations of investors (Wheaton 1999). Cap rate changes (Eq. 7) are a function of changes in NOI, risk premiums, risk-free interest rates, and the degree to which cap rates deviated from their equilibrium level in the previous time period.

Equation 6 reserves no explicit role for investor sentiment in the determination of observed cap rates. To address this potential effect, we augment the specification in Eq. 7 with several measures of investor sentiment. We also estimate variants of the second stage regression as additional robustness checks, including specifications that allow us to test whether sentiment is embedded in market participants' forecasts of income growth and expected returns.

Data

Our primary data source is the Real Estate Research Corporation (RERC). Founded in 1931 in Chicago, RERC is nationally known for its research, analysis, and investment criteria. Published quarterly in the *Real Estate Report*, the RERC Real Estate Investment Survey summarizes information on current investment criteria such as going-in (acquisition) cap rates, terminal cap rates, unlevered required rates of return on equity, expected rental growth rates, and investment conditions provided by a sample of institutional investors and managers throughout the USA[9] According to RERC, the survey results are used by investors, developers, appraisers, and financial institutions to "monitor changing market conditions and to forecast financial performance."[10] As a robustness check, we also employ survey data from Korpacz PriceWaterhouse Coopers.

[9] Several stock market studies find institutions to be informed investors; i.e., "smart money." See, for example, Chakravarty (2001), Jones and Lipson (2004), and Sias et al. (2006). However, this evidence is tempered by studies that suggest institutions do not outperform individual investors (e.g. Nofsinger and Sias 1999, and Kaniel et al. 2005).

[10] *Real Estate Report*, Summer 2002.

Ideally, our cap rate data would be based on a large number of constant-quality (including location) properties with identical lease terms. Such data do not exist. The RERC data, however, represent the cap rates respondents are currently observing in the market for notional investment grade properties of constant quality. Thus, these data are well-suited to our task, except they are not based on actual transactions.

Recall from Eq. 3 that equilibrium going-in cap rates $\left(R_t^e\right)$ are a function of unlevered discount rates (r_t) and expected growth rates in net rental income (g_t). However, r_t and g_t cannot be directly observed. Thus, in prior cap rate studies, proxies for these variables, or their component parts, were estimated. One attraction of the RERC data is that expected rental growth rates and required equity returns are two of the survey questions. In addition, survey respondents are asked to rank the "investment conditions" of various property types and markets. These ranking of investment conditions directly measure investor sentiment.

We focus first on the going-in capitalization rates reported by RERC for nine property types: apartment, hotel, industrial research and development, industrial warehouse, central business district (CBD) office, suburban office, neighborhood retail, power shopping centers, and regional malls. Survey cap rates for the nine property types are displayed in Fig. 1. During the first half of the 1996:Q1–2007:Q2 sample period, cap rates remained relatively stable. However, beginning in 2002, cap rates on all property types began to decline. For example, apartment cap rates stood at 8.7% in 2002:Q1; by 2007:Q2 they had declined 300 basis points to 5.7%.

To address potential concerns about the survey-based nature of our cap rate data, we compare RERC cap rates, by property type, to cap rates obtained from two other sources, the National Council of Real Estate Investment Fiduciaries (NCREIF) and Real Capital Analytics (RCA). NCREIF cap rates represent averages derived from

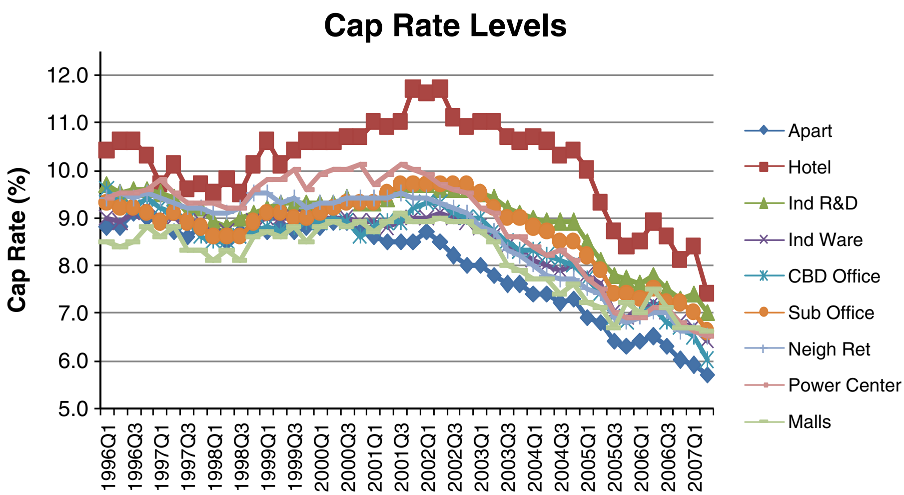

Fig. 1 Cap rate levels by property type. Cap rates are obtained from the Real Estate Research Corporation's *Real Estate Report*, which publishes results from RERC's quarterly Real Estate Investment Survey. The *Real Estate Report* summarizes the expected rates of return, property selection criteria, and investment outlook of a sample of institutional investors and managers throughout the USA. The property level cap rates displayed in this figure are aggregated across all metropolitan markets

valuations of institutional class properties held by firms that are contributing members to the NCREIF Property Index (NPI). RCA cap rates are averages derived from a much larger, but more heterogeneous, population, coming from the sales of all properties of \$5 million or more. NCREIF cap rates are appraisal-based, and hence potentially backward looking. RCA cap rates are transaction-based but potentially noisy because they are not constant quality. NCREIF data extend back to 1990, whereas RCA data begin in 2001. Correlations between RERC and NCREIF cap rate levels over the 1996:1 to 2007:2 period, and RERC and RCA cap rates over the 2001:1 to 2007:2 period, exceed 90% for all nine property types. Moreover, regressions of RERC cap rates on NCREIF (RCA) cap rates yield highly significant slope coefficients of 0.80 (0.90) and above and R^2s of 85% (90%) and above. In fact, regressions of RERC cap rates on both NCREIF and RCA cap rates together result in adjusted R^2s above 95% in almost all nine cases. The tight connection between RERC cap rates and these two alternative series indicates that our survey based cap rates are tracking pricing dynamics in commercial real estate markets very well.

Table 1 contains summary statistics, by property type, for our key RERC regression variables. The top panel contains means, standard deviations, minimums, maximums, and serial correlations of levels and changes for capitalization rates, expected rental growth rates, required equity returns, and investment conditions. Mean expected rent growth ranges from 2.3% (annually) for power centers to 2.9% for apartments. The levels of expected rent growth display substantial positive serial correlation across quarters. However, changes in expected rental growth rates display significant negative serial correlation, with the exception of apartments and hotels.

These data, coupled with our prior discussion of the cap rate determinates, provide a foundation for the analysis of the widely discussed decline in US cap rates that occurred from 2002 to 2007. Most real estate practitioners largely attribute the unprecedented decline in cap rates over this recent period to the "wall of capital" and related liquidity that has permeated many markets, although market observers do not discount the role declining interest rate levels have also played. However, inspection of the RERC data suggests a more traditional explanation. In panels A–C of Fig. 2, we plot RERC cap rates for apartments, CBD office buildings, and regional malls. Also plotted are the corresponding RERC expected rental growth rates. Theory tells us these two series should be negatively correlated, and this negative correlation is observed over the 1996:Q1 to 2007:Q2 sample period.[11] Similar correlations are observed for the remaining six property types. Thus, it appears that the large cap rate declines since 2002 have been driven, at least in part, by increases in expected rental growth.

Note also that the observed increases in RERC expected rent growth are not consistent with increased capital flows and rising prices. In fact, once market values exceed all-in construction costs, rising prices (lower cap rates) produce increased construction that, in the longer run, leads to lower real rents. Said differently, if increase capital flows and liquidity since 2002 were pushing asset values above fundamental values, then rational market participants should have been reducing their rent growth expectations, all else equal.

[11] Note that, in theory, cap rate movements are driven by variations in expected net rental income (NOI). We assume that such expectations are highly correlated with expected changes in market rental rates.

Table 1 Descriptive statistics—selective RERC variables (1996:1–2007:2)

					Serial correlation	
	Mean	SD	Min	Max	Levels	Changes
Cap rates						
Apartment	8.0	2.0	5.7	9.1	0.99	0.03
Hotel	10.1	2.0	7.4	11.7	0.93	−0.08
Industrial R&D	9.0	1.5	7.0	9.7	0.98	0.21
Industrial Warehouse	8.4	1.6	6.4	9.2	0.98	0.19
CBD office	8.4	1.8	6.0	9.6	0.98	0.34
Suburban office	8.7	1.6	6.6	9.7	0.98	0.29
Neighborhood retail	8.6	2.1	6.5	9.5	0.99	0.12
Power center	8.9	2.3	6.5	10.1	0.98	0.10
Regional malls	8.2	1.5	6.6	9.1	0.94	−0.32
Rental growth rates						
Apartment	2.9	1.2	1.5	3.6	0.92	0.00
Hotel	2.6	2.2	0.3	4.4	0.87	−0.05
Industrial R&D	2.4	1.8	0.1	3.7	0.86	−0.41
Industrial warehouse	2.6	1.4	0.9	3.7	0.92	−0.24
CBD office	2.8	1.8	0.9	4.2	0.89	−0.28
Suburban office	2.6	2.2	0.4	4.1	0.93	−0.35
Neighborhood retail	2.7	1.0	1.5	3.5	0.80	−0.47
Power center	2.3	1.2	0.7	3.5	0.69	−0.58
Regional malls	2.6	1.2	1.3	3.6	0.78	−0.44
Required unlevered IRR						
Apartment	10.2	2.3	7.6	11.3	0.99	0.18
Hotel	12.5	2.4	9.4	14.5	0.95	0.03
Industrial R&D	10.9	2.1	8.3	11.9	0.99	0.31
Industrial warehouse	10.3	2.2	7.8	11.4	0.99	0.12
CBD office	10.6	2.5	7.6	11.9	0.99	0.14
Suburban office	10.9	2.2	8.2	12.0	0.98	0.09
Neighborhood retail	10.5	2.4	7.9	11.7	0.99	0.23
Power center	10.8	2.7	7.9	12.6	0.98	0.02
Regional malls	10.5	2.4	8.1	12.0	0.97	0.04
Investment conditions						
Apartment	6.3	1.4	3.9	7.4	0.67	−0.45
Hotel	5.2	2.4	2.7	7.8	0.84	−0.26
Industrial R&D	5.3	1.5	3.9	6.7	0.81	−0.52
Industrial warehouse	6.2	1.0	5.3	7.7	0.59	−0.50
CBD office	6.0	1.5	4.6	7.3	0.81	−0.34
Suburban office	5.5	2.1	3.8	7.3	0.92	−0.45
Neighborhood retail	6.1	1.0	4.6	6.9	0.23	−0.46
Power center	4.8	2.1	3.3	6.8	0.81	−0.49
Regional malls	5.4	1.3	4.2	6.6	0.26	−0.48

Data are obtained from the RERC's *Real Estate Report*, which publishes results from RERC's quarterly Real Estate Investment Survey. The *Real Estate Report* summarizes the expected rates of return, property selection criteria, and investment outlook of a sample of institutional investors and managers throughout the USA

With the exception of hotel properties, average unlevered discount rates vary little across property types, ranging from 10.2% for apartment properties to 10.9% for industrial R&D and suburban office properties. This inability of survey respondents to detect cross property variation in *ex ante* risk premiums is somewhat surprising given the significant variation in *ex post* returns earned by the various property types

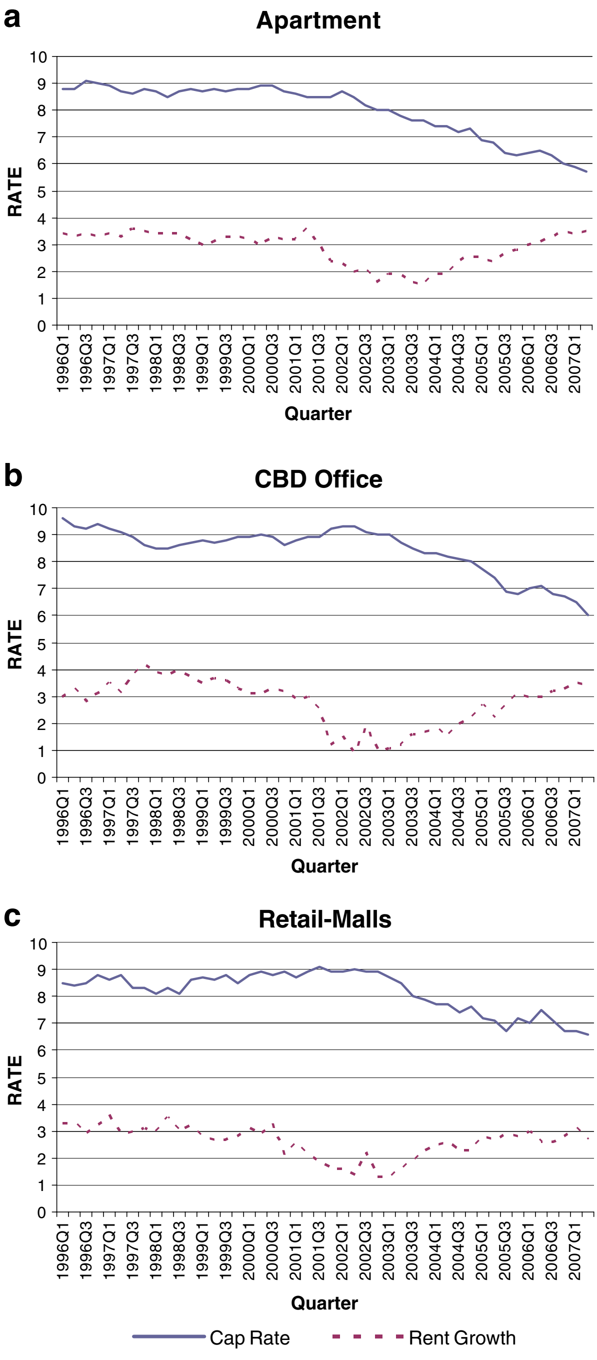

Fig. 2 Selective RERC cap rates and expected rent growth. The cap rates and expected rental growth rates are from the Real Estate Research Corporation's *Real Estate Report*, which publishes results from RERC's quarterly Real Estate Investment Survey

over different historical time horizons. Shilling (2003) and Geltner et al. (2007) report a similar finding in ex ante required returns derived from real estate investor surveys and also report that survey-based IRRs are "too sticky" and overstated, at least historically. In contrast to cap rates, IRRs are difficult to observe empirically. This raises the possibility that the RERC required IRRs may be measured with error and not capturing true variation in risk premiums over time and across properties. We recognize this and account for it in our empirical methodology.

Because OLS regressions with nonstationary variables produce spurious regression results, we test for the stationarity of our regression variables using augmented Dickey–Fuller, Phillips–Perron, and Weighted Symmetric unit root tests.[12] Each of the tests includes intercept terms, time trends, and lags of the dependent variables. Although not reported, each of the tests show that cap rates, rental growth rates, risk premiums, and T-bond yields are each non-stationary (i.e., contain a unit root), but stationary in first differences at the 5% significance level. However, Engle–Granger and Johansen–Juselius cointegration tests reveal that cap rates, rental growth rates, risk premiums, and interest rates are cointegrated, containing one cointegrating vector among the variables at the 5% level. This suggests that a long-run equilibrium cap rate relation (i.e., a cointegrating regression) can be specified in levels.

Measuring Real Estate Investor Sentiment

RERC survey respondents are asked to rank current investment conditions for each of the nine property types on a scale of 1 to 10, with 1 indicating "poor" investment conditions and 10 indicating "excellent" conditions for investing. The bottom panel in Table 1 contains summary statistics for our RERC investor sentiment variable. Note that the consensus opinion of survey respondents over the sample period was that apartment properties, with an average rank of 6.3, were considered to be the most desirable investments, followed by industrial warehouse and neighborhood retail properties. In contrast, retail power centers, with a mean ranking of 4.8, were deemed the least desirable of the nine property types over the study period. Inspection of Table 1 also reveals that RERC's investment condition rankings display a significant amount of variation over the sample period. For example, the investment desirability of hotels ranged from a low of 2.7 to a high of 7.8. RERC sentiment levels display positive serial correlation across quarters. However, changes in sentiment display significant negative serial correlation.

In addition to our RERC sentiment variable, we construct a measure of aggregate real estate investor sentiment based on observable market level variables. More specifically, following Brown et al. (2002), Brown and Cliff (2004) and Baker and Wurgler (2006), we construct an index of investor sentiment towards commercial real estate investment based on the common variation in a number of proxies for

[12] The Weighted Symmetric test is often recommended over the Dickey–Fuller test because it is more likely to reject the unit root null hypothesis when it is in fact false. That is, the weighted symmetric test has higher power. We also obtain similar results using the Phillips–Perron test. The Phillips–Perron test is a variant of the Dickey–Fuller test that addresses the problem of additional serial correlation in the residuals.

sentiment. More specifically, we extract an overall market sentiment measure from the following five sentiment-related proxies: (1) commercial mortgage flows as a percentage of GDP; (2) the percentage of properties sold from the NCREIF Property Index (NPI); (3) the ratio of the transaction based (TBI) and "constant liquidity" versions of the NPI value index; (4) the NPI total return over the past four quarters, and (5) the most recent quarterly TBI total return.[13]

Mortgage flows are widely viewed by industry participants as a barometer of market investment sentiment, in part because of the association between past real estate cycles and "excessive" mortgage flows in periods of underpricing of default risk.[14] The percentage of properties sold from the NPI and the ratio of the TBI and constant liquidity versions of the NPI index are related to transaction activity or market turnover and can also be viewed as market liquidity proxies.[15] Our final two sentiment proxies are current property returns derived from appraisal-based and transaction-based indices used by institutional investors to track investment performance. We are not claiming that each of these time series represents investor sentiment, but rather that if sentiment does exist it is likely to be reflected to some degree in each and it therefore can be extracted it as the common component.

To ensure our real estate sentiment measure is not an index of common business cycle risk factors, we first regress each of the five sentiment proxies on the 3-month Treasury yield, a term structure variable (10-year less 3-month Treasury yield), and a measure of economy-wide default risk (the Baa corporate bond yield less the AAA bond yield). We then construct our real estate sentiment index as the first principal component of the five residual series using quarterly observations over the 1984 to 2007:Q2 period. We label this variable CLN (Clayton, Ling, and Naranjo) sentiment and include it in augmented versions of our cap rate error correction model. This additional sentiment factor allows us to examine the extent to which broader measures of real estate sentiment influence capitalization rates. Figure 3 displays the CLN sentiment index and, as a check of consistency with the RERC survey data, compares it to an index constructed as the first principal component of the RERC

[13] The NCREIF property index is comprised of the same class of properties and investors as the RERC survey. The quarterly "constant liquidity" version of the NPI is developed in Fisher, Geltner and Pollakowski (2007). The authors recognize that private, relatively illiquid asset markets adjust through both changes in prices and liquidity; observed transaction prices are conditional on overall market liquidity at the time of sale (i.e., price and liquidity are jointly determined). A "constant liquidity value" of a property is the value assuming no change in the level of market transaction activity; all adjustment takes place through price. The difference between the constant liquidity and hedonic value index, based on observed transaction prices that implicitly reflect time variation in liquidity, provides a calibration of commercial property liquidity. The TBI, including its constant liquidity version, are available at the MIT Center for Real Estate website.

[14] Dokko et al. (1999) provide an overview of alternative explanations for real estate cycles that includes the potential role of mortgage flows. Pavlov and Wachter (2006) suggest that the underpricing of the borrowers' put option in non-recourse commercial mortgage loans is at the root of the link between mortgage flows and property values. Riddiough (2008) argues that the securitization boom of the past 5 years has been accompanied by mispricing mortgage default risk that once again resulted in excessive mortgage flows and a bubble in commercial property prices.

[15] Baker and Stein (2004) develop a theoretical model in which aggregate liquidity acts as an indicator of the relative presence of sentiment-based traders in the market place and therefore the divergence of asset price from fundamental value. Abnormally high aggregate liquidity (high turnover and/or low bid-ask spreads) is evidence of overvaluation and in fact forecasts a downturn in stock prices.

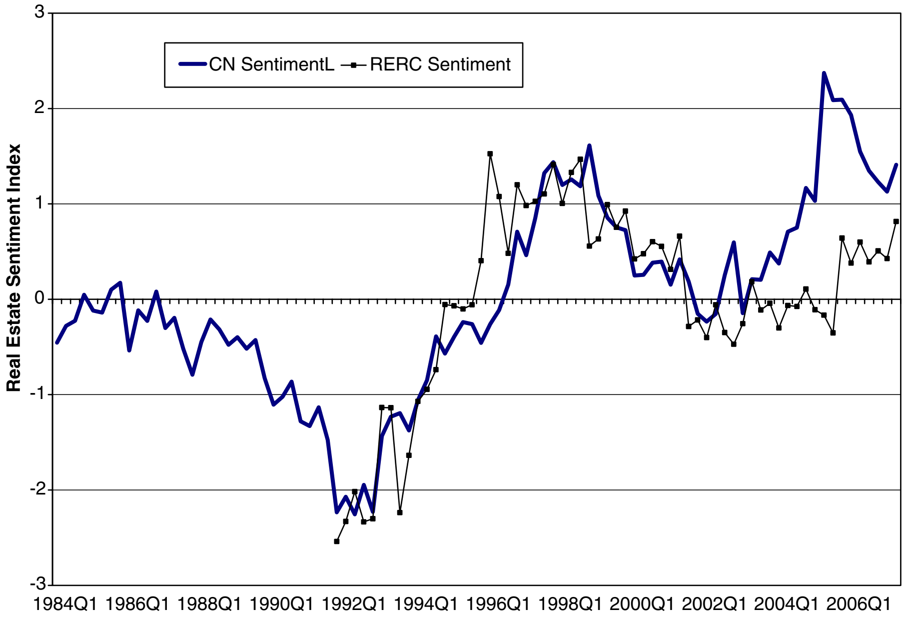

Fig. 3 Real estate investment sentiment indices. *CLN* (Clayton, Ling, Naranjo) *sentiment* is the first principal component of a group of sentiment proxies: commercial mortgage flows as a percent of GDP, transaction activity from the NCREIF Property Index (percent of properties sold from the NPI), the ratio of the MIT transaction based (TBI) and constant liquidity versions of the NPI value index, the NPI total return over the past 4 quarters, and the most recent quarterly TBI total return. *RERC sentiment* is the first principal component extracted from RERC investment condition question survey responses for nine property types

sentiment variable for the nine property types (RERC Sentiment). Overall, our two sentiment proxies display substantial co-movement; in fact, the correlation between them is 0.76 over the 1996:Q1 to 2007:Q2 period.

Results

Table 2 contains parameter estimates and *p* values (in parentheses) for our long-run model (Eq. 6) for each of the nine property types over the 1996:Q1 to 2007:Q2 period. Consistent with established cap rate theory, we include rent growth expectations, the risk premium embedded in required discount rates, and the yield to maturity on 10-year Treasury bonds as our explanatory variables.

The estimated coefficient on the contemporaneous equity risk premium and T-bond yield are positive and highly significant for all nine property types. The estimated coefficient on the risk premium ranges from 0.613 to 0.866 and averages 0.755 across the nine property types. The corresponding coefficient estimate on the T-bond yield ranges from 0.579 to 0.871. The coefficient on expected rent growth is negative and highly significant in all but the apartment, hotel, and neighborhood retail specifications. The adjusted R^2 for our nine long-run levels model averages 0.974.

Table 2 Long-run cap rate level models: 1996:1–2007:2

	Apartment	Hotel	Industrial R&D	Industrial warehouse	CBD office	Suburban office	Neighborhood retail	Power center	Mall
Constant	−0.864 (0.000)	0.986 (0.120)	1.512 (0.000)	0.905 (0.000)	1.565 (0.000)	1.652 (0.000)	−0.350 (0.057)	−0.381 (0.073)	2.334 (0.000)
Rent growth	0.021 (0.657)	−0.077 (0.198)	−0.099 (0.003)	−0.110 (0.003)	−0.221 (0.000)	−0.143 (0.000)	0.033 (0.519)	0.033 (0.449)	−0.172 (0.002)
Risk premium	0.854 (0.000)	0.765 (0.000)	0.711 (0.000)	0.757 (0.000)	0.685 (0.000)	0.705 (0.000)	0.866 (0.000)	0.837 (0.000)	0.613 (0.000)
10-Year T-bond yield	0.871 (0.000)	0.722 (0.000)	0.692 (0.000)	0.752 (0.000)	0.726 (0.000)	0.668 (0.000)	0.819 (0.000)	0.868 (0.000)	0.579 (0.000)
Adjusted R^2	0.986	0.925	0.975	0.987	0.974	0.981	0.987	0.988	0.968

P values are in parentheses. The parameter estimates are from the estimation of Eq. 6 using quarterly data over the 1996:1 to 2007:2 time period. The dependent variable is the quarterly cap rate. Rent growth is the expected change in market rental rates over the next year, risk premium in the required unlevered return on equity minus the yield to maturity on a 10-year Treasury Bond. The remaining independent variable is the 10-year Treasury Bond yield

Figure 4, panels A–C, contain plots of the actual and predicted cap rate values from the long-run equation for apartments, CBD office buildings, and regional malls, respectively. As can be seen, the estimated equations capture the broad movements in property specific cap rates, although errors do occur, suggesting the appropriateness of our error correction framework.

We next estimate our cap rate change model (Eq. 7). Quarterly changes in all variables in the long-run model are included in the error correction specifications, as well as the error correction term.[16] Table 3 reports parameter estimates and *p* values. As expected, the estimated coefficient on the change in expected rent growth is negative and significant (at the 5% level) in the CBD office, suburban office, and regional mall equations. However, the coefficient on expected rent growth is not significant in the remaining six property type regressions.

Given the theoretical importance of expected rent growth in cap rate determination, the lack of consistent significance of the RERC rent growth variable in our second-stage regressions, and the concern that our RERC rent variable may be "sentiment-laden," we experimented with several alternative proxies for income growth expectations. More specifically, we obtained historical time series of effective rents from Torto–Wheaton Research for the four main property types: office, industrial, retail, and apartments. Following Sivitanides et al. (2001), we split expectations of nominal rent growth into growth due to expected economy-wide inflation and expected real rent growth. We experimented with alternative proxies for expected economy-wide inflation, including simple extrapolations of past changes in the Consumer Price Index. We also investigated alternative proxies for real rent growth, including simple extrapolations and more rational mean-reverting expectations. In short, these alternative specifications did not improve the explanatory power of our rent growth variable; moreover, their use consumed several more degrees of freedom. Thus, we report only those results obtained using the RERC rent growth variable.

The remaining explanatory variables enter the short-run cap rate regressions with the expected sign and are highly significant. For example, the coefficient on the change in equity risk premium ranges from 0.533 to 0.794, all with *p* values of 0.000. The estimated coefficients on changes in the 10-year T-bond yield are of similar magnitude and significance. Thus, RERC cap rates strongly respond to changes in both the equity risk premium and T-bond yield, as theory suggests. These results are consistent with previous studies that find that cap rate changes are primarily driven by changing discount rates (i.e. Treasury yields and risk premiums) rather than changes in rent growth expectations (Geltner and Mei 1995; Plazzi et al. 2004).

As previously discussed, several rationales warrant the application of an error correction model to cap rates, including the lagged and smoothed nature of appraisal-based prices and cap rates. Thus, the difference between actual and predicted cap rates could reflect the aggregate effect of these underlying forces working to return the market to equilibrium (Hendershott and MacGregor 2005a). Examination of Table 3 reveals that the error correction term carries the expected negative sign and is highly significant in all nine property type regressions.

[16] The lagged cap rate change was initially included to expand the dynamic adjustment process. However, it was dropped from the analysis because in no specification was its estimated coefficient statistically significant.

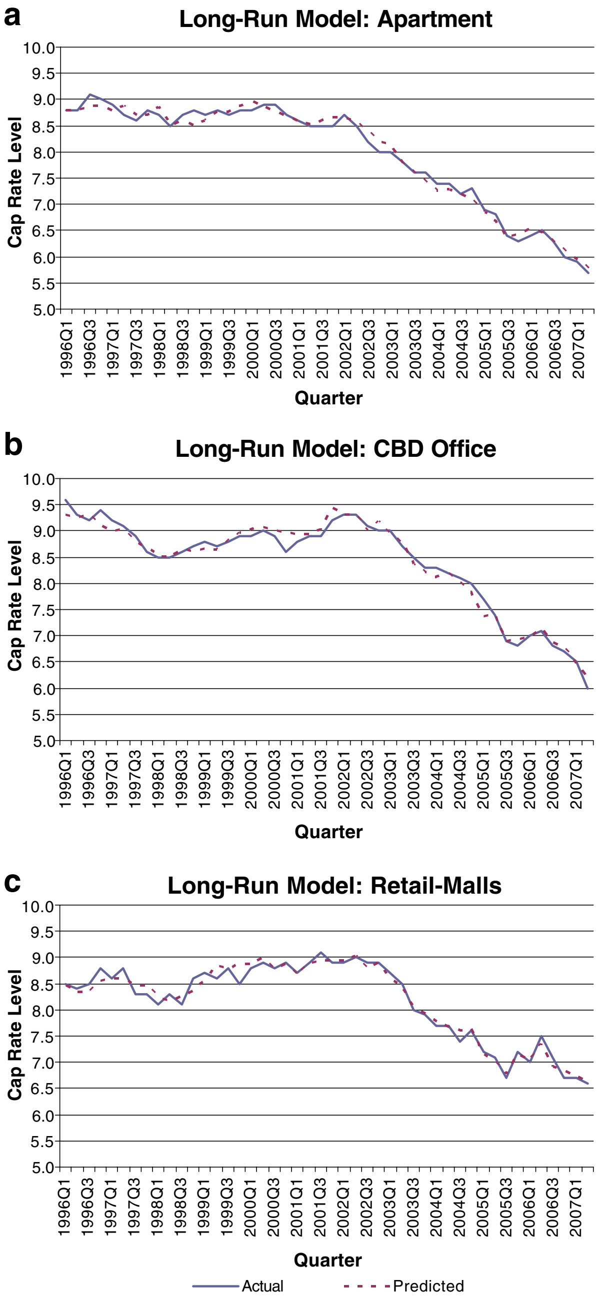

Fig. 4 Selective long-run cap rate models. The actual cap rates are from the Real Estate Research Corporation's *Real Estate Report*, which publishes results from RERC's quarterly Real Estate Investment Survey. The predicted cap rates are obtained from estimation of Eq. 6

Table 3 Short-run cap rate change models without sentiment: 1996:2–2007:2

	Apartment	Hotel	Industrial R&D	Industrial warehouse	CBD office	Suburban office	Neighborhood retail	Power center	Mall
Constant	−0.012 (0.536)	−0.001 (0.987)	−0.020 (0.200)	−0.009 (0.515)	−0.023 (0.240)	−0.016 (0.318)	−0.008 (0.638)	−0.011 (0.554)	−0.003 (0.893)
Rent growth change	0.055 (0.458)	0.006 (0.923)	−0.047 (0.110)	−0.068 (0.150)	−0.093 (0.033)	−0.081 (0.038)	−0.050 (0.262)	0.023 (0.546)	−0.174 (0.003)
Risk premium change	0.723 (0.000)	0.690 (0.000)	0.542 (0.000)	0.641 (0.000)	0.533 (0.000)	0.561 (0.000)	0.794 (0.000)	0.682 (0.000)	0.595 (0.000)
Treasury yield change	0.722 (0.000)	0.833 (0.000)	0.492 (0.000)	0.633 (0.000)	0.597 (0.000)	0.541 (0.000)	0.706 (0.000)	0.692 (0.000)	0.528 (0.000)
Error correction term	−0.576 (0.000)	−0.659 (0.000)	−0.589 (0.000)	−0.692 (0.000)	−0.706 (0.000)	−0.710 (0.000)	−0.466 (0.000)	−0.700 (0.000)	−1.019 (0.000)
Adjusted R^2	0.507	0.564	0.669	0.711	0.625	0.694	0.608	0.686	0.712

P values are in parentheses. The parameter estimates are from the estimation of Eq. 7 using quarterly data over the 1996:1 to 2007:2 time period. The dependent variable is the quarterly change in the cap rate. Rent growth change is the change in expected rental growth from quarter $t-1$ to quarter t. Risk premium change is the change in the required unlevered equity risk premium from quarter $t-1$ to quarter t. Treasury yield change is the change in the yield to maturity on a 10-year Treasury Bond from quarter $t-1$ to quarter t. The error correction term is the residual (actual minus predicted) from the long-run levels model (Eq. 6, Table 2), lagged one quarter

Finally, the adjusted R^2 averages 0.642 across the nine cap rate change specifications, with a range of 0.507 to 0.712. The actual and fitted value for our apartment, CBD office, and regional mall data are displayed in panels A–C of Fig. 5. Clearly, the error correction model picks up broad movements in cap rates.

Sentiment Effects

As previously discussed, we employ two proxies for investor sentiment. The first is the RERC "investment conditions" variable; the second is our constructed CLN sentiment index. Table 4 contains cap rate change parameter estimates and *p* values with the specification altered to include the change in RERC sentiment from time $t-1$ to t. Although negative and statistically significant in the hotel regression (*p* value = 0.064) and marginally significant in the industrial R&D and neighborhood retail equations, RERC sentiment is not significant in the remaining six property type regressions. When the change in CLN sentiment is substituted for the change RERC sentiment, the estimated coefficient is positive and significant in the industrial warehouse and neighborhood retail equations only (see panel B at the bottom of Table 4). We also experimented with contemporaneous and lagged values of RERC and CLN sentiment, as well as one, two, three, and four-quarter changes in both variables. Although several of these sentiment variables are statistically significant in one or two of the nine cap rate regressions, the lack of a consistent sentiment effect is noteworthy. These inconsistent sentiment effects are also robust over non-overlapping subsample estimates (1996–2001 and 2002–2007).

A potential concern is that some of the explanatory variables in our reduced form error-correction model are endogenous. For example, if a survey respondent is irrationally optimistic about the investment potential of a particular property type, this non fundamentals-based optimism may bias downward the respondent's required risk premium and/or bias upward his or her expectations of future rental growth. Said differently, our RERC required risk premiums and/or rental growth expectations may be sentiment laden. This, in turn, may reduce the explanatory power of our sentiment proxies in the cap rate change regressions.

To address this issue, we orthogonalized our expected rent growth and risk premium variables with respect to our sentiment variables. This orthogonalization is designed to strip these fundamental variables of sentiment and load the explanatory power of investor sentiment onto the estimated RERC and CLN coefficients in our cap rate change regressions. The results with the orthogonalized expected rent growth and risk premium variables and RERC sentiment are reported in panel A of Table 5. First, note that the adjusted R^2s are unchanged from Table 4. This is because the information on the right-hand-side of the cap rate change models is not altered by the orthogonalization of rent growth and risk premiums with respect to sentiment. However, the estimated coefficient on the change in RERC sentiment is negative and highly significant in all but the regional mall equation. Thus, although fundamentals are the primary determinants of cap rates, sentiment also has an impact on cap rate determination.

Fig. 5 Selective short-run cap rate models. The actual changes in cap rates are from the Real Estate Research Corporation's *Real Estate Report*, which publishes results from RERC's quarterly Real Estate Investment Survey. The predicted cap rates are obtained from estimation of Eq. 7 ▶

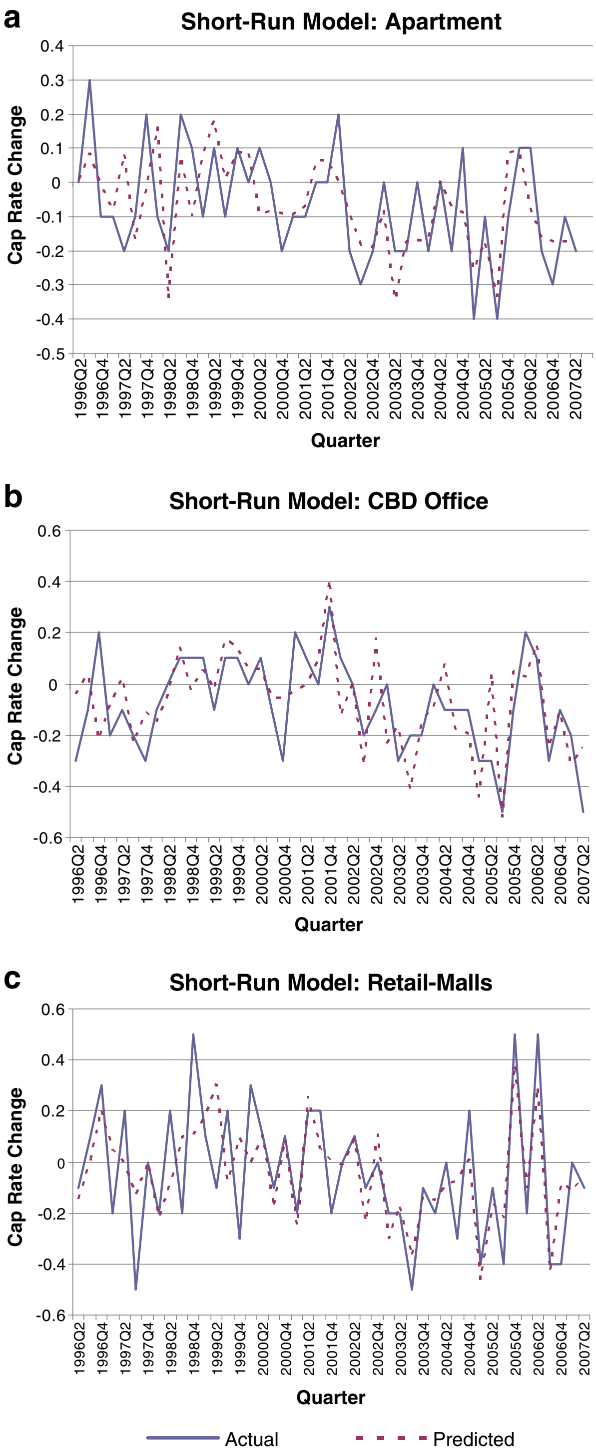
a
Short-Run Model: Apartment
Cap Rate Change
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
1996Q2 1996Q4 1997Q2 1997Q4 1998Q2 1998Q4 1999Q2 1999Q4 2000Q2 2000Q4 2001Q2 2001Q4 2002Q2 2002Q4 2003Q2 2003Q4 2004Q2 2004Q4 2005Q2 2005Q4 2006Q2 2006Q4 2007Q2
Quarter
b
Short-Run Model: CBD Office
Cap Rate Change
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
1996Q2 1996Q4 1997Q2 1997Q4 1998Q2 1998Q4 1999Q2 1999Q4 2000Q2 2000Q4 2001Q2 2001Q4 2002Q2 2002Q4 2003Q2 2003Q4 2004Q2 2004Q4 2005Q2 2005Q4 2006Q2 2006Q4 2007Q2
Quarter
c
Short-Run Model: Retail-Malls
Cap Rate Change
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
1996Q2 1996Q4 1997Q2 1997Q4 1998Q2 1998Q4 1999Q2 1999Q4 2000Q2 2000Q4 2001Q2 2001Q4 2002Q2 2002Q4 2003Q2 2003Q4 2004Q2 2004Q4 2005Q2 2005Q4 2006Q2 2006Q4 2007Q2
Quarter
Actual
Predicted

Table 4 Short run cap rate change models with sentiment: 1996:2–2007:2

	Apartment	Hotel	Industrial R&D	Industrial warehouse	CBD office	Suburban office	Neighborhood retail	Power center	Mall
Panel A									
Constant	−0.012 (0.549)	−0.009 (0.815)	−0.020 (0.189)	−0.009 (0.541)	−0.022 (0.254)	−0.016 (0.297)	−0.008 (0.613)	−0.011 (0.547)	−0.002 (0.920)
Rent growth change	0.055 (0.463)	0.008 (0.896)	−0.045 (0.125)	−0.069 (0.149)	−0.098 (0.035)	−0.079 (0.044)	−0.042 (0.342)	0.040 (0.352)	−0.181 (0.003)
Risk premium change	0.725 (0.000)	0.659 (0.000)	0.549 (0.000)	0.644 (0.000)	0.535 (0.000)	0.559 (0.000)	0.788 (0.000)	0.674 (0.000)	0.604 (0.000)
Treasury yield change	0.723 (0.000)	0.797 (0.000)	0.501 (0.000)	0.632 (0.000)	0.599 (0.000)	0.547 (0.000)	0.706 (0.000)	0.687 (0.000)	0.540 (0.000)
RERC sentiment change	0.007 (0.832)	−0.101 (0.064)	−0.045 (0.159)	0.013 (0.661)	0.014 (0.721)	−0.030 (0.429)	−0.039 (0.113)	−0.030 (0.354)	0.014 (0.635)
Error correction term	−0.585 (0.000)	−0.613 (0.000)	−0.519 (0.000)	−0.683 (0.000)	−0.708 (0.000)	−0.692 (0.000)	−0.413 (0.004)	−0.678 (0.000)	−1.027 (0.000)
Adjusted R^2	0.495	0.591	0.678	0.705	0.617	0.691	0.623	0.685	0.706
Panel B									
CLN sentiment change substituted for RERC	0.073 (0.148)	0.014 (0.905)	0.050 (0.271)	0.067 (0.080)	−0.010 (0.857)	0.045 (0.298)	0.078 (0.062)	0.052 (0.327)	0.064 (0.291)
Adjusted R^2	0.517	0.568	0.671	0.732	0.621	0.705	0.628	0.690	0.712

P values are in parentheses. The parameter estimates are from the estimation of Eq. 7 using quarterly data over the 1996:1 to 2007:2 time period. The dependent variable is the quarterly change in the cap rate. Rent growth change is the change in expected rental growth from quarter $t-1$ to quarter t. Risk premium change is the change in the required unlevered equity risk premium from quarter $t-1$ to quarter t. Treasury yield change is the change in the yield to maturity on a 10-year Treasury Bond from quarter $t-1$ to quarter t. The error correction term is the residual (actual minus predicted) from the long-run levels model (Eq. 6), lagged one quarter. In Panel B, we report the estimated coefficient on the change in CLN sentiment when it is substituted for RERC sentiment, along with the corresponding adjusted R^2 from the estimate

Table 5 Short run cap rate change models with orthogonalization: 1996:2–2007:2

	Apartment	Hotel	Industrial R&D	Industrial warehouse	CBD office	Suburban office	Neighborhood retail	Power center	Mall
Panel A									
Constant	−0.012 (0.545)	−0.007 (0.838)	−0.020 (0.190)	−0.010 (0.478)	−0.020 (0.297)	−0.014 (0.352)	−0.009 (0.560)	−0.012 (0.521)	−0.002 (0.913)
Rent growth change orthog	0.053 (0.480)	0.002 (0.975)	−0.043 (0.138)	−0.075 (0.114)	−0.071 (0.121)	−0.092 (0.019)	−0.022 (0.584)	0.045 (0.281)	−0.184 (0.002)
Risk premium change orthog	0.724 (0.000)	0.671 (0.000)	0.549 (0.000)	0.634 (0.000)	0.554 (0.000)	0.581 (0.000)	0.769 (0.000)	0.662 (0.000)	0.603 (0.000)
Treasury yield change	0.721 (0.000)	0.814 (0.000)	0.501 (0.000)	0.612 (0.000)	0.624 (0.000)	0.559 (0.000)	0.690 (0.000)	0.670 (0.000)	0.542 (0.000)
RERC sentiment change	−0.189 (0.003)	−0.554 (0.000)	−0.528 (0.000)	−0.534 (0.000)	−0.294 (0.000)	−0.516 (0.000)	−0.162 (0.000)	−0.269 (0.000)	−0.006 (0.839)
Error correction term	−0.585 (0.001)	−0.629 (0.000)	−0.517 (0.000)	−0.715 (0.000)	−0.744 (0.000)	−0.741 (0.000)	−0.506 (0.004)	−0.696 (0.000)	−1.029 (0.000)
Adjusted R^2	0.492	0.600	0.679	0.716	0.666	0.698	0.659	0.695	0.706
Panel B									
CLN sentiment change	−0.451 (0.000)	−0.741 (0.000)	−0.409 (0.000)	−0.379 (0.000)	−0.552 (0.000)	−0.545 (0.000)	−0.573 (0.000)	−0.632 (0.000)	−0.502 (0.000)
Adjusted R^2	0.517	0.568	0.671	0.732	0.621	0.705	0.628	0.690	0.712

P values are in parentheses. The parameter estimates are from the estimation of Eq. 7 using quarterly data over the 1996:1 to 2007:2 time period. The dependent variable is the quarterly change in the cap rate. Rent growth change orthog is the change in expected rental growth from quarter $t-1$ to quarter t orthogonalized with respect to RERC sentiment. Risk premium change is the change in the required unlevered equity risk premium from quarter $t-1$ to quarter t orthogonalized with respect to RERC sentiment. Treasury yield change is the change in the yield to maturity on a 10-year Treasury Bond from quarter $t-1$ to quarter t. The error correction term is the residual (actual minus predicted) from the long-run levels model (Eq. 6), lagged one quarter. In Panel B, we report the estimated coefficient on the change in CLN sentiment when it is substituted for RERC sentiment

It is also important to note that the estimated coefficients on our fundamental variables are little changed by the orthogonalization (compare panel A in Tables 4 and 5). This suggests that, although orthogonalization of the rent growth and risk premium variables is necessary to isolate the effect of sentiment on cap rates, this orthogonalization does not alter our conclusions about the effects of fundamental variables on cap rates.

We also orthogonalized rent growth and the risk premium with respect to CLN sentiment and estimated our cap rate change regressions using CLN as our proxy for investor sentiment. The estimated coefficients on CLN sentiment, reported in panel B of Table 5, are negative and highly significant in all nine property type regressions. Thus, our finding of a role for sentiment in cap rate determination is not dependent on our choice of sentiment proxy.

Robustness Results Using Alternative Database

Finally, to further examine the robustness of our results, we repeat our estimations using survey data from Korpacz Pricewaterhouse Coopers (KPC). Similar to the RERC survey, the KPC survey consists of quarterly responses from 100-odd prominent pension plans, foundations, endowments, life insurance companies, investment banks, and REITs that invest in US real estate. The KPC survey has been conducted each quarter since 1988 and contains rich information on the expectations of participants in commercial real estate markets. Survey respondents are asked to report the cap rates they are observing on CBD office buildings, major retail properties, apartment buildings, and industrial warehouses. The survey also asks respondents for their required (unlevered) rates of return and rental growth forecasts for each of these property types. Thus, the KPC survey provides us with cap rates and their fundamental determinants: expected rental growth and required rates of return. However, all retail and industrial property types are aggregated together in the KPC survey. Thus, the results are not directly comparable to our retail and industrial RERC results, which are disaggregated by subproperty type. However, the KPC data for apartments and CBD office properties are directly comparable to our RERC data.

The error correction model results using the KPC data for apartments and CBD office properties are very similar to the corresponding results from the RERC estimations over the 1996:2 to 2007:2 sample period. For example, using RERC data, we report in Table 4 that the estimated coefficients on risk premium change and Treasury yield change in the short-run CBD model (without orthoganalization) are 0.535 and 0.599, respectively, and both are highly significant. The corresponding coefficient estimates using KPC data are 0.581 and 0.476, and both estimates are, again, highly significant. The coefficient on the error correction term using the RERC data and KPC date are, −0.708 and −0.439, respectively. The only substantive difference in the results is that the estimated coefficient on rent growth change is negative and significant in the RERC estimation. Although negative, this coefficient estimate is not significant in the KPC estimation.

Our error correction model results for apartments using KPC data are also very similar to the RERC results. In particular, the estimated coefficients on risk premium change and Treasury yield change in the short-run CBD model are positive and highly significant, although the magnitude of the estimates is less than in the RERC estimations. The estimated coefficient on the error correction term is negative and significant but is also smaller in magnitude than the estimate obtained with RERC data.

Overall, the error correction results using KPC data for apartments and CBD office properties indicates that our primary findings are robust to the use of an alternative dataset.

Vector Error-Correction Model

To further examine potential endogeneity effects, we also estimate a vector error-correction model (VECM) in which all of the variables are specified as endogenous variables in a five-equation system. A VECM model is a restricted vector autoregressive (VAR) model designed for use with nonstationary time series that are cointegrated (see, for example, Hamilton 1994). A group of nonstationary time-series is cointegrated if there is a linear combination of them that is stationary. These cointegrating relations (error correction terms) are incorporated into the VECM.[17]

For example, consider the following two-variable VECM:

$$\Delta Y_t = a_1 + b_1\,\Delta Y_{t-1} + c_1\,\Delta Z_{t-1} + \alpha_1(Y_{t-1} - \beta Z_{t-1}) + e_{1t} \tag{8}$$

$$\Delta Z_t = a_2 + b_2\,\Delta Z_{t-1} + c_2\,\Delta Y_{t-1} + \alpha_2(Y_{t-1} - \beta Z_{t-1}) + e_{2t} \tag{9}$$

where all terms involving Δ are stationary. This two-variable error correction model is a bivariate VAR in first differences augmented by the error-correction terms $\alpha_1(Y_{t-1} - \beta Z_{t-1})$ and $\alpha_2(Y_{t-1} - \beta Z_{t-1})$ from the cointegrating relation. The β's contain the cointegrating equation and the α's the speeds of adjustment. In general, the kth order vector error-correction model can be represented by the following system:

$$\Delta X_t = \mu + \Gamma_1\,\Delta X_{t-1} + \Gamma_2\,\Delta X_{t-2} + \ldots + \Gamma_{k-1}\,\Delta X_{t-k+1} + \Pi X_{t-k} + e_t, \tag{10}$$

where

X_t	vector of p $I(1)$ variables,
μ	$p \times 1$ vector of intercepts,
Γ_1, Γ_2, Γ_k, Π	$p \times p$ matrices of parameters,
e_t	error term [~NID(0,Ω)],
Δ	difference operator, and
$I(1)$	integrated of order one (i.e., first-difference stationary).

In the above system, the coefficient matrix Π provides information about the long-run equilibrium (error correction) relations among the variables, while the Γ's provide information on short-run relations. If all of the elements of Π equal zero, the system becomes a traditional VAR in differences. Using Johansen's (1988) method, we first obtain the number of cointegrating vectors (rank of Π) and then the parameter estimates using the VECM.

[17] An alternative approach would be to estimate a structural equation system. However, this would require identifying restriction assumptions and would also be problematic given the non-stationary and cointegrated nature of our data.

As discussed earlier, augmented Dickey–Fuller and weighted symmetric unit root tests suggest that the variables in the system are non-stationary (i.e., we could not reject the null hypothesis of a unit root at the 5% significance level for the variables in the system). The results of Johansen's (trace) cointegration tests also indicate the existence of one cointegrating vector at the 5% level.

Table 6 reports the VECM estimation results for the cap rate equation using our RERC sentiment variable. Similar to our earlier single-equation error correction model results, we find that cap rate changes are positively related to changing Treasury yields and equity risk premiums, although the statistical significance of these two fundamental variables is reduced relative to their significance in our single equation error correction model. However, we find no consistent role for sentiment in explaining the time series variation of cap rates during the 1996:Q1 to 2007:Q2 sample period. Finally, in contrast to our earlier results, we find that the error correction term (cointegrating equation) is often insignificant in the VECM results. This finding is consistent with McGough and Tsolacos (2001) and may result from a limited degrees of freedom problem whereby numerous parameters are being estimated in the system of equations with a limited number of quarterly observations.

The estimation results for the RERC sentiment equation in the VECM also allows us to formally test whether RERC sentiment is explained by lagged changes in our two fundamental variables: equity risk premiums and expected rental growth rates. The results (not shown) indicate that changes in RERC sentiment are not driven by these two fundamental variables. In fact, the only variable that consistently explains the change in RERC sentiment in the current quarter is the prior quarter's change, although this may again reflect the inability of our sample size to fully support the estimation of the VECM.

As noted above, our inability to uncover a role for sentiment in explaining the time-series variation in cap rates over the 1996:Q1 to 2007:Q2 sample period may be the result of limited degrees of freedom in our VECM estimation using RERC data. However, the KPC data for apartments and CBD office properties extends back to 1991:Q4, providing more degrees of freedom than the RERC data. To examine the robustness of our VECM results to the use of a longer time series, we replicated the RERC VECM results reported in Table 6 using the KPC data. The results are encouraging. The estimated coefficient on risk premium chg(−1) for apartments reported in Table 6 is 0.375 (t statistic = 1.906). The corresponding estimate using the KPC data is 0.243 (t statistic = 2.625). Similarly, the coefficient on Treasury yield chg(−1) using RERC data is 0.340 (t statistic = 1.690). The corresponding estimate using the KPC data is 0.239 (t statistic = 2.474). Overall, the significance of the fundamental variables increases somewhat using a longer time series. Interestingly, unlike the RERC VECM estimations, the coefficient on Sentiment chg(−1) is negative and significant and the coefficient on Sentiment chg(−2) is positive and significant, suggesting a role for sentiment in the determination of apartment cap rates.

The use of the KPC data with a longer time series in the estimation of the CBD office VECM provides similar results. That is, coefficients on the fundamental variables carry the expected sign and significance (with the exception of expected rent growth). In addition, however, the estimated coefficient on RERC sentiment

Table 6 Vector error correction model-cap rate determinants: 1996:2–2007:2

	Apartment	Hotel	Industrial R&D	Industrial warehouse	CBD office	Suburban office	Neighborhood retail	Power center	Mall
Constant	−0.061 (−2.179)	−0.068 (−1.077)	−0.029 (−1.299)	−0.013 (−0.498)	−0.025 (−0.748)	−0.038 (−1.309)	−0.035 (−1.190)	−0.054 (−1.478)	−0.019 (−0.508)
Cap Rate Chg (−1)	−0.264 (−1.371)	−0.249 (−0.962)	−0.063 (−0.296)	−0.367 (−1.514)	0.041 (0.184)	0.074 (0.328)	−0.033 (−0.132)	−0.036 (−0.145)	−0.737 (−3.300)
Cap Rate Chg (−2)	−0.290 (−1.500)	0.026 (0.100)	−0.474 (−1.970)	−0.440 (−1.949)	−0.300 (−1.422)	−0.189 (−0.829)	−0.126 (−0.515)	−0.254 (−1.019)	−0.028 (−0.119)
Rent Growth Chg (−1)	0.001 (0.674)	0.003 (0.629)	0.001 (0.428)	−0.001 (−0.578)	−0.001 (−0.445)	0.001 (0.376)	0.002 (1.171)	0.000 (0.036)	0.000 (0.064)
Rent Growth Chg (−2)	0.004 (2.425)	0.001 (0.300)	0.001 (0.528)	0.001 (0.794)	−0.001 (−0.661)	0.000 (−0.149)	−0.002 (−0.864)	0.000 (0.126)	0.002 (0.835)
Risk Premium Chg (−1)	0.375 (1.906)	0.276 (1.206)	0.413 (2.541)	0.563 (2.476)	0.417 (2.139)	0.052 (0.286)	0.166 (0.687)	0.164 (0.850)	0.593 (3.108)
Risk Premium Chg (−2)	0.407 (2.009)	0.089 (0.392)	0.334 (1.699)	0.738 (3.154)	0.255 (1.288)	0.419 (2.320)	0.365 (1.547)	0.273 (1.443)	0.252 (1.179)
Treasury Yield Chg (−1)	0.340 (1.690)	0.129 (0.391)	0.344 (2.083)	0.545 (2.344)	0.420 (1.832)	0.100 (0.504)	0.159 (0.677)	0.147 (0.720)	0.494 (2.446)
Treasury Yield Chg (−2)	0.373 (1.792)	0.079 (0.247)	0.343 (1.794)	0.704 (2.959)	0.274 (1.357)	0.448 (2.340)	0.328 (1.436)	0.239 (1.153)	0.151 (0.673)
RERC Sentiment Chg (−1)	0.029 (0.580)	0.028 (0.267)	−0.035 (−0.649)	0.030 (0.502)	−0.050 (−0.722)	−0.158 (−1.968)	−0.016 (−0.333)	−0.007 (−0.118)	0.012 (0.185)
RERC Sentiment Chg (−2)	0.034 (0.690)	0.002 (0.014)	−0.219 (−4.210)	−0.001 (−0.019)	−0.034 (−0.487)	−0.150 (−1.739)	−0.063 (−1.326)	−0.113 (−1.748)	−0.023 (−0.383)
Vector error correction term	0.000 (0.022)	0.000 (−0.312)	−0.009 (−3.262)	0.001 (0.174)	0.001 (1.222)	−0.004 (−0.681)	0.002 (0.799)	0.001 (0.328)	−0.008 (−1.411)
Adjusted R^2	0.061	−0.188	0.360	0.167	0.085	0.117	−0.022	−0.065	0.187

P values are in parentheses. The parameter estimates are from the estimation of the equation system (10) using quarterly data over the 1996:2 to 2007:2 time period. We only report the cap rate equation estimates from each property equation system. The dependent variable in this equation from the system is the quarterly change in the cap rate. Rent growth chg is the change in expected rental growth from quarter $t-1$ to quarter t. Risk premium chg is the change in the required unlevered equity risk premium from quarter $t-1$ to quarter t. Treasury yield chg is the change in the yield to maturity on a 10-year Treasury Bond from quarter $t-1$ to quarter t. The vector error correction term is from the estimated cointegrating equation chg(−1) is −0.257 (*t* statistic = −2.220). In summary, the use of the VECM, which allows all variables in the system to be estimated endogenously, also suggests a statistically significant role for sentiment when the longer KPC time series is used.

Time Variation in the Dispersion of Cap Rates, Rent Growth and Discount Rates

Our earlier single-equation error correction results suggest that sentiment plays a role in commercial property cap rate determination, once we account for the sentiment embedded in the expected rent growth and risk premiums. In addition to endogeneity issues, another potential concern is that our testing approach implicitly assumes that if sentiment impacts prices it does so at all times. That is, sentiment is essentially another variable in the property pricing equation. However, sentiment may only play a pricing role in "up" or "hot" markets.[18] Short-sale constraints inhibit the ability of rational investors to eliminate overpricing and may imply that irrational investors are only active in the market when they are overly optimistic. Hence, in up markets, asset values reflect the sentiment of these irrational traders. Our tests of a role for sentiment, therefore, may have relatively low power because sentiment is not important in all periods in the sample.

To address this concern, we provide an additional test for the role of sentiment in property pricing dynamics. More specifically, we examine the time series of the coefficient of variation of RERC cap rates, rent growth, discount rates and sentiment, calculated across the nine property types each quarter and test whether variation over time in these cross-sectional dispersion series is related to investor sentiment, after controlling for macroeconomic fundamentals. If sentiment does impact pricing, then we expect that in periods of high sentiment there will be less cross-sectional dispersion in cap rates and discount rates because all assets in a given "bucket" experience the upswing. That is, cross-property dispersion in pricing will decrease as co-movement in returns tightens and is delinked from co-movement in cash flow and risk fundamentals due to coordinated sentiment-based trading (Barberis et al. 2002). In contrast, cross-sectional variation is likely to increase during economic downturns (Plazzi et al. 2008). periods

Figure 6 presents the time series of cross-property standard deviations (top graph) and coefficients of variation (bottom graph) of the RERC regression variables. Note that, starting in 2000, the dispersion of RERC sentiment across the nine property types declines, with the dispersion of cap rates and discount rates following soon thereafter. Interestingly, there does not appear to be any systematic change in the variation of rent growth expectations over this time period, except for the much higher coefficient of variation during the recession of 2002, suggesting that the decrease in discount rate and cap rate dispersion is either a sentiment or a capital market (i.e., denominator) phenomenon.

To investigate whether the lower volatility resulting from convergence across property types represent rational repricing based on economic fundamentals or,

[18] See, for example, Baker and Stein (2004). Yu and Yuan (2007) also find that irrationality is more prevalent in rising markets.

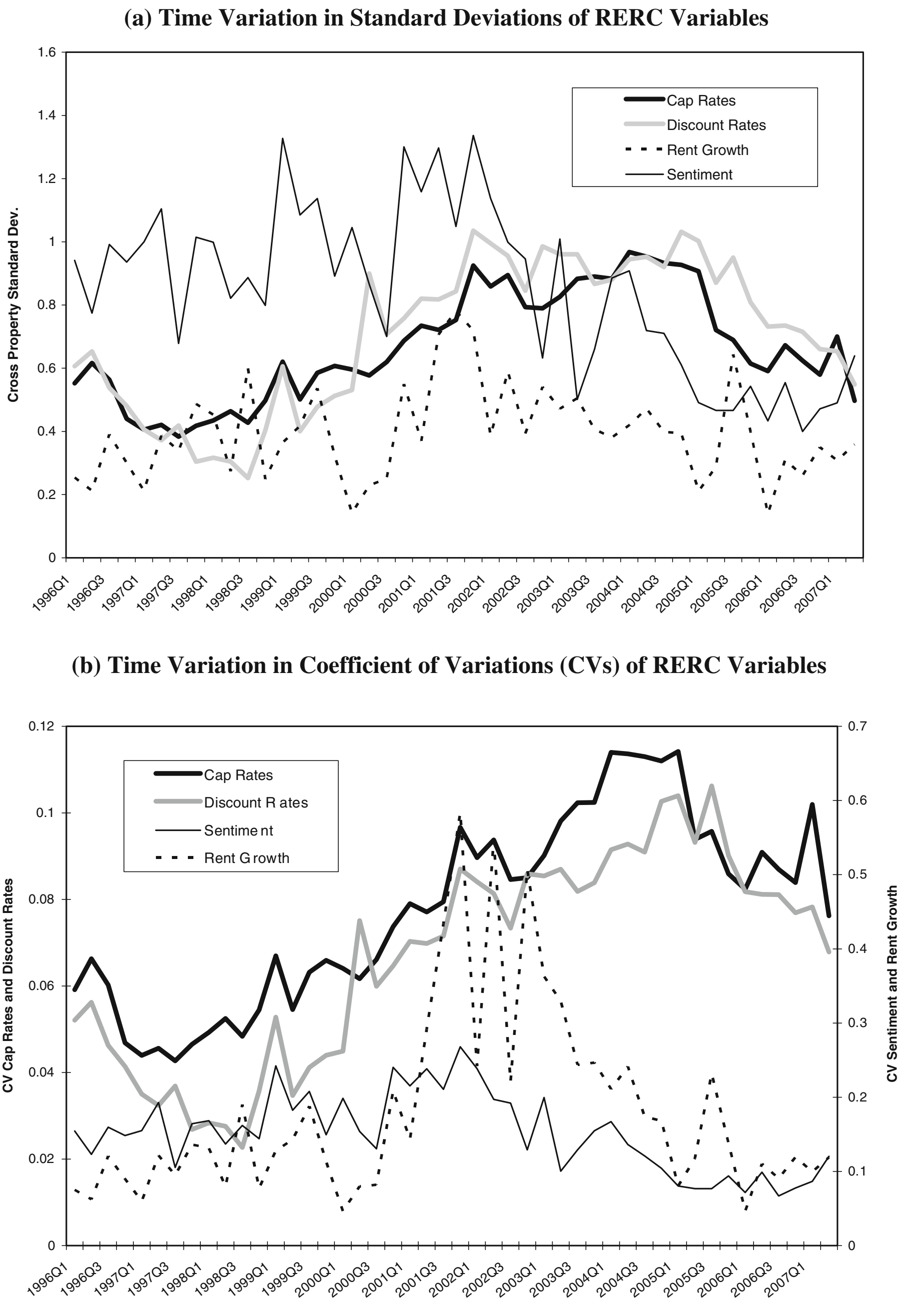

Fig. 6 Time series of dispersion of RERC variables across nine property types

instead, derives from investor sentiment, we regress the time series of cross property standard deviations on our CLN sentiment measure and three economic factors that have been found to be related to business cycle risks in previous studies; the 3-month Treasury yield, the Treasury term structure, and a corporate default premium variable.[19] All explanatory variables are lagged to avoid simultaneity bias, and lagged dependent variables are included as regressors to account for slow adjustment over time. Table 7 reports the estimation results. Cross-property dispersion in cap rates is strongly persistent and the coefficients on both the 3-month Treasury yield and CLN sentiment are statistically significant and negative. Hence, high investor sentiment predicts a decrease in the cross-property dispersion of cap rates, consistent with our hypothesis about a convergence in pricing during a hot market. We obtain similar results with the IRR dispersion equation, although the statistical significance is not quite as high as in the cap rate equation. Finally, sentiment does not appear to affect the variation in rental growth rates. Overall, these findings suggest that the decrease in cap rates and required returns over the past 5-to-6 years is a capital market phenomenon that may, in part, reflect investor sentiment.

Conclusion

Classical finance price theory posits no role for investor sentiment, capital flows, or trading activity. Rather, assets are assumed to trade in frictionless markets where unemotional investors force prices to equal the rational present value of expected future cash flows. However, the inability of the standard present value model to explain several dramatic run-ups and subsequent crashes in asset prices has led to a burgeoning "behavioral" finance literature. This behavioral paradigm allows for the existence of both irrational investors and limits to arbitrage. In these models, investor sentiment, capital flows, and trading volume can have a role in the determination of asset prices—independent of market fundamentals.

Private commercial real estate markets differ substantially from public stock markets. First, real estate assets are decidedly heterogeneous. Therefore, unlike the listed shares of a firm for which close substitutes exist either directly of indirectly, the unique location and other attributes of commercial real estate assets severely restrict an investor's set of acceptable substitutes. Moreover, these heterogeneous assets trade in illiquid, highly segmented and informationally inefficient local markets. As a result the search costs associated with matching buyers and sellers are significant. The inability to short sell private real estate also restricts the ability of sophisticated traders to enter the market and eliminate mispricing, especially if they believe property is overvalued. Limits to arbitrage could therefore be expected to lead to deviations of prices from fundamental values in the presence of sentiment investors.

These characteristics of private real estate markets would seem to render them highly susceptible to sentiment-induced mispricing and, indeed, there is a widespread belief among many real estate market participants that real estate markets are subject to fads (i.e., swings in sentiment). Many real estate practitioners devote considerable effort to understanding market sentiment (i.e., what other investors might do), rather than focusing solely on cash flow and discount rate considerations. In fact, the significant reduction in capitalization rates that occurred

[19] The version of the CLN sentiment index used here is the principal component of the sentiment proxies after first orthogonalizing each proxy by regressing it on the three economic fundamental variables.

Table 7 Significance of economic factors versus sentiment in explaining the time series behavior of cross-property type dispersions in cap rates, discounts rates and rent growth expectations

	Dependent variable		
	Cross property type standard deviation of		
	Cap rate	IRR	Rent growth
Intercept	0.5766 (0.01)	0.5185 (0.04)	0.2780 (0.34)
Dependent variable (−1)	0.5441 (0.00)	0.7215 (0.000)	0.2545 (0.13)
3 Mth Tsy (−1)	−0.0604 (0.02)	−0.0577 (0.08)	−0.0076 (0.84)
Term spread (−1)	−0.0310 (0.25)	−0.0370 (0.350)	0.0085 (0.87)
Credit spread (−1)	−0.0137 (0.85)	−0.0779 (0.46)	−0.0458 (0.75)
CLN sentiment (−1)	−0.0312 (0.03)	−0.0326 (0.08)	−0.0148 (0.54)
Adjusted R^2	84.3%	80.9%	4.4%

P values are in parentheses. The parameter estimates are from regressions of the standard deviation of the cap rate, rent growth and discount rate, calculated each quarter across nine property types, on economic conditions and sentiment, using quarterly data over the 1996:2 to 2007:2 time period. Cap rate, rent growth and discount rate data were obtained from the Real Estate Research Corporation's *Real Estate Report*, which publishes results from RERC's quarterly Real Estate Investment Survey. The *Real Estate Report* summarizes the expected rates of return, property selection criteria, and investment outlook of a sample of institutional investors and managers throughout the USA. Business cycle conditions are measured by the 3-month Treasury yield, a term structure variable (10-year less 3-month Treasury yield) and a default premium variable (Baa corporate bond yield less AAA bond yield). CLN sentiment is the first principal component from a group of potential real estate investment sentiment proxies including commercial mortgage flows as a percentage of GDP, institutional property transaction activity and liquidity measures as well as property returns in the most recent quarter and over the past year

in most commercial real estate markets from 2002 to 2007 is largely, if not entirely, attributed to the surge in sentiment-driven capital flows that occurred during this period (Downs 2004; House 2004).

Despite the potential importance of fundamentals and investor sentiment in private real estate pricing dynamics, no research exists that directly examines the relative influence of fundamentals and investor sentiment in commercial real estate pricing. This paper examines the extent to which fundamentals and investor sentiment explain the time-series variation in property-specific national cap rates.

In our analysis, we apply a new dataset to the study of cap rate determinants that includes direct fundamentals and both survey (direct) measures of investor sentiment and composite (indirect) measures of investor sentiment constructed from a set of potential sentiment proxies. Direct survey measures of investor sentiment, along with cap rates, unlevered equity discount rates, and expected rent growth for nine property types at both the national and MSA-level are taken from the *Real Estate Report,* published quarterly by the Real Estate Research Corporation (RERC). The nature of the RERC data set also allows us to utilize an innovative modeling and econometric approach to the analysis of the relation between sentiment and property pricing. More specifically, we derive an equilibrium model of cap rates specified as a function of real estate space and capital market fundamentals that is estimated using error-correction techniques, thereby capturing both short and long-run dynamics.

Our results show that fundamentals are the key driver of cap rates. However, sentiment also plays a pricing role over our 1996–2007 study period.

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References

Archer, W. A., & Ling, D. C. (1997). The three dimensions of real estate markets: Linking space, capital, and property markets. *Real Estate Finance Fall*, 7–14.

Baker, M., & Stein, J. (2004). Market liquidity as a sentiment indicator. *Journal of Financial Markets 7*, 271–299.

Baker, & M., Wurgler, J. (2006). Investor sentiment and the cross-section of stock returns. *Journal of Finance 61*(4), 1645–1680.

Baker, M., & Wurgler, J. (2007). Investor sentiment in the stock market. *The Journal of Economic Perspectives 21*, 129–151.

Barberis, N., Shleifer, A., & Wurgler, J. (2005). Comovement. *Journal of Financial Economics 75*, 283–317.

Barberis, N., & Thaler, R. (2003). Chapter 18: A survey of behavioral finance. In: ConstantinidesG. M., HarrisM., StulzR. (eds) *Handbook of the Economics of Finance*, pp 1053–1128. vol. 1. Elsevier, Amsterdam.

Brown, G., & Cliff, M. (2004). Investor sentiment and the near term stock market. *Journal of Empirical Finance 11*, 1–27.

Brown, G., & Cliff, M. (2005). Investor sentiment and asset valuation. *Journal of Business 78*(2), 405–440.

Brown, S., Goetzmann, W., Hiraki, T., Shiraishi, N., & Watanabe, M. (2002). Investor sentiment in Japanese and U.S. Daily Mutual Fund Flows. Yale Working Paper.

Campbell, J., Shiller, R. (1998). The dividend-price ratio and expectations of future dividends and discount factors. *Review of Financial Studies 1*, 195–228.

Chakravarty, S. (2001). Stealth-trading: Which trader's trades move stock prices? *Journal of Financial Economics 61*, 289–307.

Chen, J., Hudson-Wilson, S., & Nordby, H. (2004). Real estate pricing: Spreads and sensibilities: Why real estate pricing is rational. *Journal of Real Estate Portfolio Management 10*, 1–21.

Chichernea, D., Miller, N., Fisher, J., Sklarz, M., & White, R. (2008). A cross sectional analysis of cap rates by MSA. *Journal of Real Estate Research 30*(3) (forthcoming).

Clayton, J. (2003). Capital flows and asset values: A review of the literature and exploratory investigation in a real estate context. Homer Hoyt/University of Cincinnati Working Paper.

Clayton, J., MacKinnon, G., & Peng, L. (2008). Time variation of liquidity in the private real estate market: An empirical investigation. *Journal of Real Estate Research 30*(2) (forthcoming).

De Long, J. B., Shleifer, A., Summers, L. H., & Waldmann, R. J. (1990). Noise trader risk in financial markets. *Journal of Political Economy 98*(4), 703–738.

Dokko, Y., Edelstein, R., Lacayo, A., & Lee, D. (1999). Real estate income and value cycles: A model of market dynamics. *Journal of Real Estate Research 18*(1), 69–96.

Downs, A. (2004). Some aspects of the real estate outlook. Retrieved from http://www.anthonydowns.com.

Edelen, R. M., & Warner, J. B. (2001). Aggregate price effects of institutional trading: A study of mutual fund flow data and market returns. *Journal of Financial Economics 59*(2), 195–220.

Engle, R., & Granger, C. W. J. (1987). Cointegration and error correction: Representation estimation and testing. *Econometrica 55*, 251–276.

Fama, E., & French R. (2007). Disagreement, tastes, and asset prices. *Journal of Financial Economics 83*(3), 667–689.

Fisher, J., Ling, D. C., & Naranjo, A. (2007). Commercial real estate return cycles: Do capital flows matter? University of Florida/RERI Working 1aper.

Fisher, J., Geltner, D., & Pollakowski H. (2007) A Quarterly Transactions-based Index of Institutional Real Estate Investment Performance and Movements in Supply, and Demand. *Journal of Real Estate Finance and Economics 34*(1), 5–33.

Froot, K. A., O'Connell, P. G. J., & Seasholes, M. S. (2001). The portfolio flows of international investors. *Journal of Financial Economics 59*(2), 151–194.
Geltner, D. M., Miller, N. G., Clayton, J., & Eicholtz P. (2007). *Commercial Real Estate Analysis and Investments*, 2nd edn. South-Western Publishing, Cincinnati, OH.
Geltner, D., & Mei J. (1995). The present value model with time-varying discount rates: Implications for commercial property valuation and investment decisions. *The Journal of Real Estate Finance and Economics 11*(2), 119–135.
Gompers, P., & Lerner, J. (2000). Money chasing deals? The impact of fund inflows on private equity valuations. *Journal of Financial Economics 5*, 281–325.
Greene, W. (1993). *Econometric analysis*, 2nd edn. Prentice Hall, Englewood Cliffs.
Griffin, J., Nardari, F., & Stulz, R., (2007). Do investors trade more when stocks have performed well? Evidence from 46 countries. *The Review of Financial Studies 20*(3), 905–951.
Hamilton, J. D. (1994). *Time series analysis*. Princeton University Press, Princeton.
Hendershott, P. H., & MacGregor, B. (2005a). Investor rationality: Evidence from U.K. Property Capitalization Rates. *Real Estate Economics 26*, 299–322.
Hendershott, P. H., & MacGregor, B. (2005b). Investor rationality: An analysis of NCREIF commercial property data. *Journal of Real Estate Research 26*, 445–475.
Hirshleifer, D. (2001). Investor psychology and asset pricing. *Journal of Finance 56*, 1533–1597.
House, G. C. (2004). Demand for Real Estate: Capital Flows, Motivations, and the Impact of Rising Rates. Institute for Fiduciary Education.
Jones, C. M., & Lipson, M. (2004). Are retail orders different? Working Paper, Columbia University.
Johansen, S. (1988). Statistical Analysis of Cointegrating Vectors. *Journal of Economic Dynamics and Control 12*, (2–3), 231–254.
Kaniel, R., Saar, G., Titman, S. (2005). Individual investor sentiment and stock returns. Working Paper, Duke University.
Ling, D. C. (2005). A random walk down main street: Can experts predict returns on commercial real estate. *Journal of Real Estate Research 27*(2), 137–154.
Ling, D. C., & Naranjo A. (2003). The dynamics of REIT capital flows and returns. *Real Estate Economics 31*, 405–434.
Ling, D. C., & Naranjo, A. (2006). Dedicated REIT mutual fund flows and REIT performance. *Journal of Real Estate Finance and Economics 32*(4), 409–433.
McGough, T., & Tsolacos, S. (2001). Do yields reflect property market fundamentals? Working Paper, City University Business School.
Nofsinger, J. R., & Sias, R. W. (1999). Herding and feedback trading by institutional and individual investors. *Journal of Finance 59*, 2263–2295.
Pavlov, A. D., & Wachter, S. M. (2006). Underpriced lending and real estate markets. Retrieved at SSRN from http://ssrn.com/abstract=980298
Plazzi, A., Torous, W. N., & Valkanov, R. (2004). Expected returns and the expected growth in rents of commercial property. Working Paper, The Anderson School at UCLA.
Plazzi, A., Torous, W. N., & Valkanov, R. (2008). The cross-sectional dispersion of commercial real estate returns and rent growth: time variation and economic fluctuations. *Real Estate Economics* (in press).
Riddiough, T. (2008). On the addictive properties of cheap and easy debt capital. *PREA Quarterly*, Winter issue, 30–37.
Shilling, J. D. (2003). Is there a risk premium puzzle in real estate? *Real Estate Economics 31*(4), 501–525.
Shilling, J. D., Sing, T. F. (2007). Do institutional real estate investors have rational expectations? Working Paper.
Sias, R., Starks, L. T., & Titman, S. (2006). Changes in institutional ownership and stock returns: Assessment and methodology. *Journal of Business 79*, 2869–2910.
Sivitanidou, R., & Sivitanides, P. (1999). Office capitalization rates: Real estate and capital market influences. *Journal of Real Estate Finance and Economics 18*(3), 297–322.
Sivitanides, P., Southard, J., Torto, R., & Wheaton, W. (2001). The determinants of appraisal-based capitalization rates. MIT Working Paper.
Warther, V. A. (1995). Aggregate mutual fund flows and security returns. *Journal of Financial Economics 39*, 209–235.
Wheaton, W. (1999). Real estate cycles: Some fundamentals. *Real Estate Economics 27*, 209–230.
Yu, J., & Yuan, Y. (2007). Investor sentiment and the mean-variance relation. Working Paper, Wharton School, University of Pennsylvania.