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New Insights into the NAV Spread Puzzle of Listed Real Estate:

Idiosyncratic and Systematic Evidence

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Abstract

This paper presents novel insights into the NAV spread puzzle of listed real estate. We find that: 1) Long-term credit market indicators help explain the NAV spread puzzle. An increase in the default spread increases the NAV discount and decreases the NAV premium; 2) increasing positive stock market sentiment (not limited to real estate) reduces NAV discounts; and 3) a company's increasing ability to bear its liabilities and cost of debt, represented by the interest coverage ratio, reduces NAV spreads. We control for the well-established explanatory factors found by previous research, such as size, risk, leverage, and liquidity. We also analyze divergences in the factors explaining NAV spreads by differentiating among REIT status, region, sector, and strategy. The analysis is based on monthly data over the 2005-2014 period for a global sample of 447 listed real estate companies (REITs and REOCs) in twelve countries. This rich setting offers substantial heterogeneity in NAV spreads and idiosyncratic and systematic factors across time and across countries. We believe this is the first paper to address NAV spreads in a global setting.

Key Words: Listed Real Estate, Value Stocks, Growth Stocks, Net Asset Value Spread

JEL Classification: tbd

1 Introduction

The term NAV spread refers to deviations in share prices of listed real estate stock (i.e., real estate operating companies (REOCs) and real estate investment trusts (REITs)) and underlying fundamental net asset values (NAV). NAV spreads can occur as positive deviations, expressing a premium to NAV, or as negative deviations, expressing a discount to NAV.[1]

Given Fama's (1970) efficient market hypothesis (EMH), financial markets should *"at any time 'fully reflect' all available information,"* including the intrinsic value of a listed company. To the extent that NAVs are a robust measure of underlying asset value, large and persistent deviations do not seem rationally justified or explainable. This phenomenon is referred to as a "puzzle," because research has not yet found a comprehensive and universal explanation for these deviations.

Over the past twenty-five years, the NAV spread puzzle of listed real estate has triggered few relevant studies. However, the subject is vital for both investors and management of listed real estate companies because of, e.g., the risk of takeovers in the case of substantial discounts (Adams and Venmore-Rowland, 1990). Existing studies have identified company-specific factors (e.g., company size, leverage ratio, and risk) over exogenous factors (e.g., marketwide sentiment) as explanatory approaches for the appearance of NAV spreads. They nevertheless leave a research gap, which we try to narrow with this study.

First, we present four innovative factors that may help explain the NAV spread puzzle: the interest coverage ratio, the default and term spreads as interest rate proxies, and marketwide (non-real estate) sentiment. Second, we conduct a global study covering the most relevant markets based on a uniform panel dataset. And, third, we present the first study that combines both idiosyncratic and systematic factors based on a global panel dataset.

Our empirical approach uses a global panel of 447 listed real estate companies (337 REITs and 110 REOCs) in 12 countries over the 2005-2014 period. We find the following:

[1] We follow the classification and nomenclature of Woltering et al. (2018). Accordingly, NAV spreads are calculated as follows: $NAV\ spread_{i,t} = \frac{Price_{i,t}}{NAV_{i,t}} - 1$.

1) Increasing company size reduces NAV discounts and increases NAV premiums, which can be explained by economies of scale and the popularity of large stocks among investors.
2) Increasing company-specific risk increases discounts because the risk of potential defaults decreases attractiveness among investors. Contrary to existing research, rising leverage reduces the discount and increases the NAV premium accordingly, which can be explained by a potentially positive leverage effect on the return on equity.
3) Long-term credit market indicators help explain the NAV spread puzzle: An increase in the default spread increases the discount and decreases the premium. However, the results for the short-term credit market indicator term spread do not help solve the NAV spread puzzle.
4) Increasing positive stock market and property sector sentiment reduces NAV discounts, as prior research has found. This is in line with the noise trader theory.

The remainder of this paper is organized as follows. Section 2 reviews the related literature and introduces our hypotheses. The data and methodology are described in section 3, while section 4 describes and discusses our empirical results. Section 5 concludes, and offers an outlook for future studies.

2 Literature review and hypothesis development

The extant literature overwhelmingly refers to the closed-end fund literature when explaining deviations in share prices and NAVs of listed real estate. Traditionally, the closed-end fund literature has developed two main approaches to explaining NAV spreads: 1) the “rational” approach considers company-specific factors (e.g., company size, liquidity, risk, and leverage), while 2) the “noise trader” or “sentiment” approach points to irrational marketwide investor behavior. The common ground of the factors analyzed historically is that they are either company-specific (= idiosyncratic) or marketwide (= systematic).

For clarification, we categorize the factors as either idiosyncratic or systematic. Rehkugler et al. (2012) argue that *"most studies suffer from the pure focus on company-specific factors while neglecting market-driven factors and market sentiment."* We address this shortcoming by controlling equally for factors that are attributable to both groups based on a global panel dataset. In the following sections, we analyze

the literature regarding the most influential factors that explain NAV spreads and develop our hypotheses accordingly.

2.1 Idiosyncratic factors

Size and liquidity

Previous research has documented divergent results for *company size*. Capozza and Korean (1995), Clayton and MacKinnon (2000), Brounen and Laak (2005), and Ke (2015) show that increasing company size narrows NAV spreads. In contrast, Barkham and Ward (1999), Morri et al. (2005), and Bond and Shilling (2003) find no significant relationship between NAV spreads and size. The economic rationale behind the size factor is that large REOCs or REITs have easier access to capital markets due to economies of scale. They likely profit from synergies as well as deeper knowledge of certain regional property markets. Brounen and Laak (2005) also argue that large REOCs and REITs are more popular among investors, and should thus feature fewer price to NAV deviations.

In this context, another important factor related to company size is *liquidity*. Large companies that are popular among investors are likely to exhibit high stock market liquidity. In one of the first papers addressing the NAV spread puzzle, Adams and Venmore-Rowland (1990) argued that the stock market liquidity of a firm is linked to company size. Clayton and MacKinnon (2002) and Morri and Baccarin (2016) use bid-ask spreads as proxies for liquidity. Barkham and Ward (1999), Clayton and MacKinnon (2002), and Brounen and Laak (2005) find a negative relationship between NAV discounts and liquidity using different liquidity proxies. Morri and Baccarin (2016) confirm the latter findings, but only for French REITs. They do not find any significant relation between Dutch or U.K. REIT liquidity and NAV discounts.

Considering the hypothesized effects of size and liquidity on NAV spreads, we formulate our first hypothesis as follows:

Hypothesis 1: *NAV spreads of REOCs and REITs increase with increasing size and liquidity.*

Leverage and company-specific risk

Previous research has also explored the role of leverage (the ratio of a company's debt to equity) in the context of NAV spreads. However, the results are ambiguous. Bond and Shilling (2003), Brounen and Laak (2005), Ke (2015), and Morri and Baccarin (2016) report that increasing leverage increases discounts to NAV. Other studies (Barkham and Ward, 1999; Rehkugler et al., 2012) find no significant relationship. In contrast, Clayton and MacKinnon (2000), Morri et al. (2005), and Nellessen and Zuelch (2011) report positive and significant coefficients.

The rationale behind the negative relationship can be explained by turning to the finance literature. Fama and French (1995) and Hahn and Lee (2006) find that value stocks (those with high book-to-market ratios/discounts to fundamental value) tend to be more leveraged than growth stocks (those with low book-to-market ratios/premiums to fundamental value). They are thus more prone to financial risk.

Brounen and Laak (2005) argue that leverage increases risk and risk is expected to increase the discount to NAV. The question at hand is: How can we proxy for company-specific risk? Adams and Venmore-Rowland (1990) argue that it is not sufficient to proxy for risk merely by using financial gearing. They argue that relative performance measures like the beta factor are equally critical to use because they represent asset performance relative to the overall stock market. Moreover, several studies show that company-specific risk is expected to widen the discount to NAV. Bond and Shilling (2003), Morri et al. (2005), and Morri and Baccarin (2016) use the beta factor as a proxy for risk and find that increasing risk increases the discount.

One factor that combines leverage, risk, and return is the ability of a company to bear its liabilities and cost of debt. The interest coverage ratio might be an appropriate measure to proxy for this ability. Although Bromiley (1991) finds that the interest coverage ratio is positively correlated with a company's performance, there is no evidence of this in the literature on the NAV spreads of listed real estate thus far.

To reflect the literature and the economic rationale presented, we hypothesize about the potential impacts of leverage, risk, and the interest coverage ratio as follows:

Hypothesis 2*: *NAV spreads of REOCs and REITs decrease with increasing leverage and with increasing risk.

2.2 Systematic factors

Leading credit market indicators

Patel et al. (2009) find that NAV spreads are attributable to various risk premiums that are required by investors in public stock markets and private property markets. They provide evidence that risk premiums of public stock markets (U.K. REITs) are cointegrated with macroeconomic factors such as interest rates, while private property market premiums (represented by the U.K. IPD index) are not. To the best of our knowledge, Patel et al. (2009) comes closest to exploring macroeconomic factors in the wider context of the differing market behavior of listed and direct real estate markets.

However, Patel et al. (2009) do not directly link the NAV spreads of individual REOCs or REITs to changing macroeconomic factors such as interest rates. We find this research gap surprising, because macroeconomic factors, especially interest rates, seem intuitively relevant for real estate stocks. Accordingly, there are three obvious *channels* through which interest rates may impact the returns of listed real estate companies: 1) the relative attractiveness of equities versus other asset classes such as fixed income or the money market (*capital market channel)*, 2) the real estate company's operating performance (*corporate channel*), by influencing a firm's cost of debt, and 3) the underlying property values (*property channel*). Patel et al. (2009) point this out by arguing that *"credit availability and the interest rate are one of the most important macroeconomic factors, which affect the risk premium."*

The finance literature provides solid support for the links between value and growth stocks and interest rates, although these studies do not focus specifically on real estate. Lewellen (1999), for example, argues that the low ratio of price to fundamental value ("value stocks") is especially prone to changing macroeconomic factors due to the "distress factor" suggested by Fama and French (1995). Lioui and Maio (2014) use a macroeconomic asset pricing model, and find that value stocks have higher interest rate risk than growth stocks.

Hahn and Lee (2006) proxy for interest rates by using the *default* and *term spread*.[2] These yield spreads are popular leading macroeconomic indicators used to proxy for the credit market and monetary policy conditions. Hahn and Lee (2006) provide evidence that value stocks have higher (positive) loadings on positive changes in the term spread than on growth stocks by the default and term spread. Note that increasing default spreads (DEF) indicate that the market is expecting worsening credit market conditions, while increasing term spreads (TERM), on the other hand, are associated with declining interest rates (Hahn and Lee, 2006).

To reflect the finance literature and the empirical findings on the links between NAV spreads and leverage, we formulate our third hypothesis as follows:

Hypothesis 3: *NAV spreads of REOCs and REITs decrease with increasing default spreads and increase with increasing term spreads.*

Market sentiment

In their seminal paper on the noise trader model (NTM), De Long et al. (1990) point out that there are two types of agents in financial markets: rational and irrational investors. The latter can be referred to as "noise traders," as they typically act based on non-fundamental information (e.g., rumors, market myths) and sentiment (i.e., irrational incitement like greed, panic, fear, or gut instincts). Noise trader sentiment is unpredictable, marketwide, and thus considered a systematic risk factor (noise trader risk). Analyzing the NAV spreads of EU resident REITs, Mueller and Pfnuer (2013) confirm five implications[3] of the NTM. In particular, they find that NAV spreads can be explained by sentiment, and they recommend that future research should consider both rational fundamental factors and irrational sentiment factors.

Barkham and Ward (1999), Clayton and MacKinnon (2000), Ke (2015), and Morri and Baccarin (2016) proxy for noise trader sentiment by using the average property sector discount. Each study finds a significant influence on NAV spreads, and that sentiment increases the explanatory power of the applied

[2] We provide a thorough definition of the two factors in the "Data and Methodology" section.
[3] The five implications are: 1) negative long-term average of the NAV spread, 2) alternations between premia and discounts, 3) correlations among NAV spreads, 4) correlations with other sentiment indicators, and 5) equity issues in premium periods (Mueller and Pfnuer, 2013).

models. Rehkugler et al. (2012) construct the latent variable *market sentiment*, which is composed of 1) country sentiment, 2) real estate sentiment, 3) IPO activity, 4) revaluation gains, and 5) a switching variable controlling for different country-specific magnitudes of NAV spreads. Their semi-rational model explains 76% of variations in NAV spreads. Their study highlights the importance of controlling for sentiment in the context of NAV spreads.

In a recent working paper, Jandl and Fuerst (2016) present several innovative sentiment proxies. They are the first to find that *news sentiment* (as a proxy for information supply) is significant in explaining NAV spreads, while *online search behavior* (as a proxy for information demand) is not. While most of the studies use sectorwide mispricing (i.e., average property sector NAV premiums/discounts), Morri and Benedetto (2009) use a benchmark index as a proxy for sentiment.

In our study, we apply three proxies for market sentiment. Following the reviewed literature, we use 1) sector average NAV spreads by country. Then, to control for market sentiment not limited to real estate, we use 2) marketwide average price-to-book ratios in the respective countries, and, finally, we use 3) marketwide average price-earnings ratios. (2) and (3) are alternative and innovative factors that capture the notion that NAV spreads may be contingent upon non-real estate-specific marketwide sentiment.

Reflecting the literature, we hypothesize about the potential impact of the three sentiment indicators as follows:

Hypothesis 4**:** *NAV spreads of REOCs and REITs increase with increasing average property sector NAV spreads and with marketwide sentiment as represented by the average price-to-book and price-earnings ratios in a country.*

Overall, the reviewed literature on the NAV spread puzzle of listed real estate can be summarized as follows: The vast majority of papers analyzes U.S. markets. European markets are predominantly represented by the U.K. market. To the best of our knowledge, there is no one study that analyzes relevant global markets with a uniform dataset. The emphasis is generally on REITs in contrast to REOCs. Most of the studies use index time series instead of precise company-level data, and cover short and outdated sample periods. Only a few studies combine both idiosyncratic and systematic factors. The next section presents our approach to rectifying these data shortcomings.

3 Data and methodology

3.1 Sample description

We choose our sample based on the constituents of the FTSE EPRA/NAREIT Global Real Estate Index.[4] The constituents are listed companies with *"relevant real estate activities."* Four ground rules regarding the underlying REOCs and REITs ensure sufficient index quality: 1) a minimum free-float market capitalization, 2) minimum liquidity requirements, 3) a minimum share of EBITDA (> 75%) from relevant real estate activities,[5] and 4) publication of audited annual accounting reports in English.[6]

The sample period for our analysis is 2005:01 to 2014:05. To avoid survivorship bias, we consider historic changes in the index constituent composition in each month of the period. Our final sample consists of 447 stocks from 12 countries,[7] and includes 337 REITs and 110 REOCs. The advantages of panel data include increasing degrees of freedom, weakening of multicollinearity, construction of more realistic behavioral models, and more precise estimates of micro relations (Hsiao, 2014). Together with Yavas and Yildirim (2009), our study is one of the few to apply firm-level data. Yavas and Yildirim (2009) argue that firm-level data is advantageous when performing causality and correlation tests in a NAV spread context.

3.2 Derivation of NAV per share

We calculate NAV per share (or the book value of equity) by dividing Datastream's "common equity" by "number of shares." The discount to NAV is calculated based on the "unadjusted share price" as reported by Datastream.

Following Woltering et al (2018), we limit the bulk of our sample to property-holding companies from countries with fair value-based or similar accounting regimes. The introduction of International Financial Reporting Standards (IFRS) in 2005 increased the comparability of accounting data across

[4] Brounen and Laak (2005) find that index membership is a significant factor that reduces the discount to NAV.
[5] Defined as "the ownership, trading and development of income-producing real estate."
[6] http://www.epra.com/research-and-indices/indices/.
[7] The U.S., the U.K., Germany, Belgium, Sweden, France, Netherlands, Hong Kong, Australia, Canada, Singapore, and Japan.

countries. IFRS accounting emphasizes reporting assets at their fair value, in contrast to historical cost-based accounting. In the case of property-holding companies, the assets consist primarily of regularly appraised property values. Assuming that other assets and liabilities are also reported close to market value, the book value of equity (or the net asset value, NAV) of property-holding companies can be seen as a "sum of the parts" valuation of a company, where each property is appraised using property-specific risk-adjusted discount rates. This provides a unique setting in which to study discrepancies between market prices and estimates of intrinsic value across countries.

According to U.S. GAAP, assets are generally reported at historical cost as opposed to fair value. Thus, for U.S. real estate stocks, rather than using book values, we obtain NAV estimates from SNL Financial. These historical NAV estimates are calculated as the average from all analysts that cover a specific real estate stock. For the U.S. sample, the NAV estimates are updated even more frequently than those for the IFRS countries, which are updated only when new quarterly reports are issued. Because stocks may also trade at a premium to NAV, we follow Woltering et al (2018), and name our dependent variable the “NAV spread.”

At this point, we find it appropriate to clarify the nomenclature of "NAV spreads," "NAV discounts," and "NAV premiums." Past research has used a variety of definitions and notations. For clarification, when we talk about *NAV spread increases*, we mean reductions in NAV discounts and increases in NAV premiums. *Decreases in NAV spreads* refer to increases in NAV discounts and decreases in NAV premiums. This is in line with Woltering et al.’s (2018) definition of NAV:

$$NAV\ spread_{i,t} = \frac{Price_{i,t}}{NAV_{i,t}} - 1 \quad (1)$$

with $NAV\ spread_{i,t} > 1$ = NAV premium, and

$NAV\ spread_{i,t} < 1$ = NAV discount.

3.3 Idiosyncratic and systematic factors

We derive the idiosyncratic and systematic factors in accordance with existing research. Our data sources are EPRA, Datastream, Morningstar, and publicly accessible databases such as FRED (Federal

Reserve Economic Data) from the St. Louis Fed and the Statistical Data Warehouse of the European Central Bank. Detailed definitions are provided in the following sections. For clarification, we report the expected signs in the panel regression in accordance with our hypotheses.

Idiosyncratic factors

SIZE: In selecting the size factor, we follow Clayton and MacKinnon (2000), and observe market capitalization (in millions USD) of a REOC or REIT i in month t. According to Hypothesis 1, an increasing size factor is expected to narrow the NAV spread, while decreasing the NAV discount. Thus, the expected sign in the panel regression model is (+).

LEV: Leverage is proxied for by the ratio of total debt to total assets. According to Hypothesis 2, an increasing leverage ratio is expected to widen the NAV spread, while increasing the NAV discount. The expected sign in the panel regression model is (-).

ICR: The ratio of EBIT to interest expenses (interest coverage ratio) represents the ability of a company to bear its liabilities and cost of debt with the aid of the company's operating earnings. An increasing ICR is associated with an improving ability of a REOC or REIT to pay its debt, thus reducing financial risk. Therefore, the expected sign in the panel regression model is (+).

BETA: We derive twelve-month rolling betas for each REOC and REIT in our sample. We determine $\beta_{iM,t}$ ("BETA") using the CAPM:

$$R_{it} - R_{ft} = \alpha_i + \beta_{iM,t}\left[R_{mt} - R_{ft}\right] + \varepsilon_{it} \qquad (2)$$

where R_{it} is the total return of REOC/REIT *i* in month *t*, R_{ft} is the risk-free rate, and R_{mt} is the monthly return of the market portfolio proxy. In accordance with Hypothesis 2, increasing BETA represents increasing risk relative to the market portfolio. NAV spreads are thus expected to widen. Therefore, the expected sign in the panel regression model is (-).

Systematic factors

Interest rate proxies for DEF and TERM: Akimov et al. (2015) argue that, due to the transmission mechanism, interest rate proxies of different maturities are not independent of each other. Consequently,

they cannot be incorporated into a model simultaneously. To address this issue, we follow the finance literature (Hahn and Lee, 2006; He et al., 2003), and make use of the *default spread* and the *term spread*. They allow us to simultaneously test the effect of more than one interest rate proxy in a single model. We derive the default spread and term spread as per the literature. The default spread (*DEF*) of country *j* in month *t* is calculated as follows:

$$DEF_{j,t} = CBY_{j,t} - LTIR_{j,t} \quad (3)$$

where $CBY_{j,t}$ is the redemption yield of quality (investment-grade) corporate bonds of country *j* in month *t*, and $LTIR_{j,t}$ is the long-term interest rate (ten-year government bond yield) of country *j* in month *t*. Increasing default spreads (DEF) indicate that the market is expecting worsening credit market conditions (Hahn and Lee, 2006). With Hypothesis 3 in mind, the expected sign in the panel regression model is (-).

The term spread (*TERM*) of country *j* in month *t* is calculated as follows:

$$TERM_{j,t} = LTIR_{j,t} - STIR_{j,t} \quad (4)$$

where $LTIR_{j,t}$ is the long-term interest rate (ten-year government bond yield), and $STIR_{j,t}$ is the short-term interest rate (one-year deposit rate) of country *j* in month *t*. Increases in the term spread are associated with declining interest rates (Hahn and Lee, 2006). Because falling interest rates are expected to reduce the cost of debt and improve the relative attractiveness of real estate stocks, the expected sign in the panel regression model is (+).

Sentiment proxies: Previous research has concentrated on real estate market sentiment by controlling for average property sector deviations between share prices and NAVs. We proxy for the real estate sector spread (**Sector_Spr**) by using the monthly average NAV spread of the EPRA index constituents in country *j*. The expected sign is (+). That is, increasing sector NAV spreads in a country are a signal of increasing (positive) sentiment, while decreases are a signal of negative sentiment. Thus, the NAV spreads of individual stocks are expected to increase in the following month.

Previous research failed to differentiate between real estate sentiment and marketwide sentiment. Because market sentiment is usually not limited to real estate, marketwide noise trader risk is considered accordingly. We extend existing research and control for two additional marketwide factors. **PTB_ctr** is the average marketwide price-to-book ratio of all stocks traded in a country. **PEr_ctr** is the marketwide price-to-earnings ratio of all stocks traded in a country, and an alternative measure for the optimism or pessimism of investors regarding the development and growth of stock markets relative to fundamental operating performance. Consistent with our Hypothesis 4, and the arguments for **Sector_Spr**, the expected sign for both proxies is (+).

Control factors

We obtain the following additional control factors for a smaller number of observations. We incorporate them into an additional "control model" in order to obtain improved substantiation as well as further robustness of our hypotheses.

TAXRt is the corporate tax rate of a company in %. Following previous research (e.g., Ke, 2015), the tax rate is expected to have a negative sign (-) in the panel regression.

BA_Spr of REOC/REIT *i* in month *t* is calculated as follows:

$$BA\_Spr_{i,t} = \frac{AskPrice_{i,t} - BidPrice_{i,t}}{AskPrice_{i,t}} * 100 \qquad (5)$$

Note that an increasing bid-ask spread signals decreased liquidity. Thus, in accordance with Hypothesis 2, the expected sign in the panel regression is (-).

PEratio is the price-earnings ratio of an individual REOC/REIT, and represents a traditional measure of relative attractiveness of value versus growth stocks. Because increases in the PE ratio are expected to be a sign of future stock price growth, the expected sign in the context with NAV spreads is (+).

NAVgrowth controls for the changes in the underlying net asset values over the preceding twelve months. Because increasing NAVs are expected to narrow the NAV spread, the expected sign in the panel regression is (+).

3.4 Empirical model

To test Hypotheses 1-4 and the effect of the presented idiosyncratic and systematic factors on NAV spreads of individual stocks, we run the following panel regression model:

$$NAV\ Spread_{\ i,t} = \alpha_i + \beta_1 SIZE_{i,t} + \beta_2 LEV_{i,t} + \beta_3 ICR_{i,t} + \beta_4 BETA_{i,t} + \beta_5 \Delta DEF_{j,t} + \beta_6 \Delta TERM_{j,t} + \beta_7 PTB\_ctr_{j,t-1} + \beta_8 PEr\_ctr_{j,t-1} + \beta_9 Sector\_Spr_{j,t-1} + \varepsilon_{i,t} \quad (6)$$

where i = stock, t = month, and j = country.

We consider formula (6) the "main model," because it analyzes the factors with an optimum number of combined observations for idiosyncratic and systematic factors (N = 20,768). In additional analyses, we control for further factors that are not explicitly discussed in the hypothesis development section. The number of observations is significantly smaller (N = 8,309), but still satisfactory to obtain reliable results and assess the stability of the main model. We call formula 7 our "control model":

$$NAV\ Spread_{\ i,t} = \alpha_i + \beta_1 SIZE_{i,t} + \beta_2 LEV_{i,t} + \beta_3 ICR_{i,t} + \beta_4 BETA_{i,t} + \beta_5 \Delta DEF_{j,t} + \beta_6 \Delta TERM_{j,t} + \beta_7 PTB\_ctr_{j,t-1} + \beta_8 PEr\_ctr_{j,t-1} + \beta_9 SectorSpr_{j,t-1} + \boldsymbol{\beta_{10} TAXRt_{i,t}} + \boldsymbol{\beta_{11} BA\_Spr_{i,t}} + \boldsymbol{\beta_{12} PEratio_{i,t}} + \boldsymbol{\beta_{13} NAVgrowth_{i,t}} + \varepsilon_{i,t} \quad (7)$$

where i = stock, t = month, and j = country.

We use panel regressions with fixed effects to empirically test our hypotheses. Hausman's model specification test reveals that the difference in coefficients of our models is systematic, signaling that a fixed effects estimation should be preferred over a random effects specification.

In order to get additional profound insights into the NAV spread explanation, we run the main model with four subpanels: 1) REITs versus REOCs, 2) global regions, 3) a sectoral focus, and 4) strategy. Previous studies have analyzed subpanels along various dimensions: REIT status (Bond and Shilling, 2003; Ke, 2015), regions (Morri and Baccarin, 2016), and sectoral focus and strategy (Capozza and Korean, 1995; Brounen and Laak, 2005), with differing results. The subpanel analysis allows us to draw conclusions from certain regional, sectoral, or regulatory characteristics when explaining NAV spreads.

4 Empirical results

4.1 Summary statistics

Table 1 shows the summary statistics for NAV spreads and for idiosyncratic and systematic factors over the 2005-2014 period. As shown in column 1, the REOCs and REITs in our sample trade on average at a slight NAV premium of 0.20. The standard deviation of 0.92 reveals that NAV spreads are rather dispersed and volatile. The average company size in our sample is 3.91 billion USD, while the leverage ratio is slightly below 50%. The average ICR of 6.64 shows that the REOCs and REITs in the sample bear their liabilities fairly well. However, the relatively low median and the large minimum and maximum values indicate high dispersions among individual stocks. The 0.79 average beta factor shows that the REOC and REIT returns are slightly less risky relative to the return of the market portfolio.

The leading indicators for monetary policy are in line with economic intuition. DEF, at 1.96% p.a., is on average larger than TERM (0.66% p.a.). This reveals that the average corporate bond yield is higher than long-term interest rates. As with economic intuition, average short-term rates tend to be the lowest, which is expressed by the positive term spread. The sentiment factor **PTB_ctr** for the overall market is 0.97, which is higher[8] than the average real estate sector spread. Moreover, the marketwide price-earnings ratio (**PE_ratio**) is considerably smaller than the price-earnings ratio (**PEratio**) of the individual REOCs and REITs.

Table 2 gives the results for the cross-correlations of the dependent and explanatory variables in our panel regression model. Note that NAV spreads are significantly and positively correlated with LEV, ICR, the three sentiment proxies, and the corporate tax rate. On the other hand, NAV spreads are significantly and negatively correlated only with DEF. Except for LEV, the significant correlation results provide preliminary evidence for our hypotheses. To gain solid proof, however, we test the mutual influence of the entire set of idiosyncratic and systematic factors on NAV spreads with the help of our panel regression models.

[8] Note that the price-to-book ratio provided by Datastream is calculated differently than the NAV spread: $PB = \frac{P}{B}$ (no subtraction of 1).

4.2 Regression results

Overall results

Table 3 reports the regression results of the main model, which are shown in column (4). Except for LEV, the coefficients on the four idiosyncratic factors exhibit the hypothesized sign: Increasing SIZE and ICR increase NAV spreads (i.e., reduce discounts). SIZE, LEV, and BETA are significant at the 0.1% level, while ICR is significant at the 5% level. In line with previous research, the increasing risk (BETA) decreases NAV spreads and thus increases discounts. The results for LEV are contrary to Hypothesis 2, but not inexplicable. The results are similar to those of Clayton and MacKinnon (2000), Morri et al. (2005), and Nellessen and Zuelch (2011), who also report positive and significant coefficients.

Increasing leverage can have a positive effect on NAV spreads by virtue of the positive *leverage effect*. Thus, increased financing may have a positive effect on return on equity from an investor's perspective. Other potential explanations for the positive sign on leverage are decreases in agency costs (Morri and Baccarin 2016) triggered by increasing pressure on management, as well as increased transparency by elaborate monitoring measures carried out by creditors (Nellessen and Zuelch, 2011).

We note that the systematic factors DEF and TERM show ambiguous results. DEF is negative and significant at the 1% level. In other words, a widening default spread is associated with a decrease in NAV spreads. This is also in concert with the general notion that widening default spreads are interpreted as signals of worsening credit market conditions.

The coefficient on TERM is negative but insignificant, which is inconsistent with Hypothesis 3 and rather unanticipated. The stepwise regressions of models 1-3 in Table 3 reveal that the effect of TERM is absorbed gradually by including the sentiment factors. This highlights that DEF and TERM are obviously reliable proxies for credit market sentiment.

The three sentiment factors show positive and significant coefficients, which is in line with Hypothesis 4. That is, NAV spreads accompany increasing sectorwide and marketwide real estate price-earnings ratios.

Table 4 reports the results for the control model (small sample) with four additional idiosyncratic factors. The results are generally in line with Table 3 and confirm the stability of the main model: Only the results for ICR and TERM stand out. In contrast to the main model, TERM shows the expected sign, but is not statistically different from zero. TAXRt, BA_Spr, and the PEratio show the expected sign, but are also not significant. NAVgrowth is significant, but the negative sign is in contrast to what is expected. The results show that NAV spreads widen with increasing underlying NAVs. This indicates that NAV spreads may be determined to a greater extent by share price changes than by changes in the underlying real estate assets.

Subpanel evidence

Tables 5 and 6 show the results for the four subpanels. The most important results are as follows:

REIT status: In essence, the results here are in line with the overall evidence. The conspicuous pattern is that the magnitude of the interest rate and sentiment coefficients is greater for REOCs than for REITs. To conclude, REOCs seem to be more sensitive to changes in the credit market and to sentiment.

Region: DEF is negative and significant for all three regions, but the sign for TERM appears as hypothesized only for Asia. This is surprising, as a negative term spread indicates that NAV spreads widen with decreasing interest rates. We explore this result further in the “Discussion” section.

Sector: The seven sectors reveal remarkably divergent results. The high interest rate sensitivity of the hotel and specialty sector is particularly noteworthy. The NAV spreads of residential and industrial sector REOCs and REITs do not appear to be sensitive to credit market developments.

Strategy: Companies with a strategy of holding and leasing properties are especially prone to risk (BETA). The non-rental strategy (e.g., property development and trading) is attributed to a strong dependence on market sentiment.

4.3 Discussion

The results for TERM are inconsistent among the subpanels. The literature has demonstrated two key explanatory indicator roles of the term spread. First, TERM is an indicator for interest rate developments (Hahn and Lee, 2006). In other words, an increasing TERM indicates falling interest rates.

Second, in line with this notion, TERM is an indicator for business cycle fluctuations. In a seminal paper, Fama and French (1989) argue that TERM is highest in business cycle troughs following a recession. In the aftermath, TERM is expected to increase due to falling short-term rates as a result of expansionary monetary policy to stimulate the economy. The significant negative sign of TERM indicates that falling interest rates widen NAV spreads and increase the discounts accordingly. This is contrary to our hypothesis that property companies are expected to profit from falling interest rates (as per the three channels discussed earlier).[9]

However, as the subpanel evidence shows, a highly negative and significant coefficient on TERM is especially likely with REOCs, the hotel and specialty sector, and a company's pursuit of a rental strategy. Thus, the negative coefficient might indicate a time lag problem, given that NAV spreads are highly negative as in the presented subpanels. Hotel and specialty REOCs with a rental strategy may also be especially prone to recessions. Thus, a recession can be seen as more distressing for those subpanels. Furthermore, as Fama and French (1989) argue, TERM is linked to short-term business conditions, while DEF is reflective of long-term business conditions.

To summarize, DEF is negative and significant in nearly all models and subpanels. Therefore, it is expected that NAV spreads will be correlated more strongly with changes in long-term than in short-term business conditions.

This leads to another important discussion on NAV spreads: The timing nature of NAV mispricing. Liow and Li (2006) find that NAVs and stock prices[10] are cointegrated in the long run, and exhibit a mean-reverting relationship. However, they cannot ascertain the average time lapse or speed of stock

[9] Capital market channel (stock price), company channel (operating performance), and property channel (underlying real estate properties/NAV).
[10] Stock prices in eight Asian-Pacific-listed real estate markets between 1995 and 2003.

price and NAV adjustments in the short run. In an earlier study, Liow (2003) finds that mean reversion is slow and not stable in the long run. This underpins the importance of timing in the context of NAV spreads.

Patel et al. (2009) find mean reversion evidence for U.K. REITs. They argue against the varying risk and return expectations of investors on the capital market and property channels, and against the non-cointegration between the property channel and macroeconomic factors. This is in line with Barkham and Ward (1999), who conclude that NAV spreads are due to the differing prospects of investors on the channels, namely, the differing return expectations between stocks and the underlying properties and the irrationality of noise traders in the property market. It seems obvious that the individual channels react differently to changes in the idiosyncratic and systematic factors analyzed in this study.

To get a more profound understanding of the NAV spread puzzle, it is crucial to prove which of the three channels effects the pricing of NAV spreads. Yavas and Yildirim (2011) contribute to this question by finding evidence that the pricing of NAV spreads generally takes place in the stock market (channel) rather than in the property channel. However, as with our analysis, several of their subpanels exhibit diverging results. As a consequence, we acknowledge that one limitation of our study is that we only control for the stock market channel.

Despite providing evidence for systematic and idiosyncratic factors, as well as discussing the timing issue, our study leaves room for the question of how much the NAV spread puzzle is truly a puzzle.[11] That is, are the deviations between stock prices and NAVs justified, given that NAVs may contain all the relevant information? The underlying NAV fair values are determined through property valuation, which is commonly suspected of being lagged in time, using inconsistent valuation methods, and being burdened with systematic anticipation of past values. Yet the underlying IFRS fair values may diverge from the "true value," even though stock market investors may have already priced it (see Nellessen and Zuelch, 2011). Deeper insights into the property channel might answer this question.

[11] We thank the participants of the Regensburg-Konstanz doctoral seminar for raising this question.

5 Conclusion

Our findings largely confirm our four hypotheses: 1) Increasing company size reduces NAV discounts and increases NAV premiums, which can be explained by economies of scale and the popularity of large stocks among investors; 2) increasing company-specific risk increases the discount, since the risk of potential default decreases attractiveness among investors. Contrary to Hypothesis 2, rising leverage reduces the discount and increases the NAV premium accordingly, which can be explained by a potential positive leverage effect on the return on equity; 3) long-term credit market indicators help explain the NAV spread puzzle by increasing the default spread, increasing the NAV discount, and decreasing the NAV premium. However, the results for the short-term credit market indicator term spread do not help solve the NAV spread puzzle, and 4) increasing positive stock market and property sector sentiment reduces NAV discounts. This was found by past research, and is in line with the noise trader theory.

Our paper contributes to existing research in several ways. As one of the few combining studies, we confirm the most relevant idiosyncratic and systematic factors from past studies for a large global panel of real estate stocks in explaining the NAV spread puzzle. We also present four innovative factors to explain the NAV spread puzzle: the interest coverage ratio, the default and term spreads as interest rate proxies, and marketwide (non-real estate) sentiment. Finally, despite the overall analysis, we provide evidence for underlying subpanels including REIT status, region, sector, and strategy.

Future research could contribute to the NAV spread puzzle by providing deeper insights into the underlying company and property channel. Studying the role of interest rates on the direct property market and the timing nature of real estate appraisal could be very instructive. Furthermore, considering alternative NAV measures like the EPRA NAV could provide a better understanding of whether the NAV spread puzzle is really a puzzle. In this regard, it might be appropriate to consider non-linear models and other econometric approaches.

6 References

Adams, A., Venmore-Rowland, P., 1990. Property share valuation. Journal of Valuation 8, 127–142. https://doi.org/10.1108/EUM0000000003279.

Akimov, A.S.S., 2014. Non-Linear Mean Reversion in the Discount to Net Asset Value of Public Real Estate Firms [WWW Document]. 21st Annual European Real Estate Society Conference in Bucharest, Romania. URL http://eres.scix.net/cgi-bin/works/Show?eres2014_72 (accessed 9.13.17).

Akimov, A.S.S., et al,. 2015. PLEASE ADD REFERENCE.

Barkham, R., Ward, C., 1999. Investor Sentiment and Noise Traders: Discount to Net Asset Value in Listed Property Companies in the U.K. Journal of Real Estate Research.

Bond, S.S.J., Schilling (TEXT STATES BOND & SCHILLING) 2003. An Evaluation of Property Company Discounts in Europe [WWW Document]. 10th European Real Estate Society Conference (10-13 June 2003) Helsinki, Finland. URL http://eres.scix.net/cgi-bin/works/Show?eres2003_121 (accessed 1.21.18).

Bromiley, P., 1991. Testing a Causal Model of Corporate Risk Taking and Performance. Academy of Management Journal 34, 37–59. https://doi.org/10.2307/256301.

Brounen, D., Laak, M., 2005. Understanding the Discount: Evidence from European Property Shares. Journal of Real Estate Portfolio Management 11, 241–251.

Brounen, D., Ling, D.C., Prado, M.P., 2013. Short Sales and Fundamental Value: Explaining the REIT Premium to NAV. Real Estate Economics 41, 481–516. https://doi.org/10.1111/reec.12004.

Capozza, D., Korean, S., 1995. Property Type, Size and REIT Value. Journal of Real Estate Research 10, 363–379. https://doi.org/10.5555/rees.10.4.1774176783v31848.

Clayton, J., MacKinnon, G.H., 2000. Explaining the Discount to NAV in REIT Pricing: Noise or Information? (SSRN Scholarly Paper No. ID 258268). Social Science Research

Network, Rochester, NY.

Clayton, J., and MacKinnon, G.H. 2002. PLEASE ADD REFERENCE.

De Long, J.B., Shleifer, A., Summers, L.H., Waldmann, R.J., 1990. Noise Trader Risk in Financial Markets. Journal of Political Economy 98, 703–738.

Fama, E.F., 1970. Efficient Capital Markets: A Review of Theory and Empirical Work. Journal of Finance 25, 383. https://doi.org/10.2307/2325486.

Fama, E.F., French, K.R., 1989. Business conditions and expected returns on stocks and bonds. Journal of Financial Economics 25, 23–49.

Fama, E.F., French, K.R., 1995. Size and Book-to-Market Factors in Earnings and Returns. Journal of Finance 50, 131–155. https://doi.org/10.1111/j.1540-6261.1995.tb05169.x.Hahn, J., Lee, H., 2006. Yield spreads as alternative risk factors for size and book-to-market. Journal of Financial and Quantitative Analysis 41, 245–269.

He, L.T., Webb, J.R., Myer, F.N., others, 2003. Interest rate sensitivities of REIT returns. International Real Estate Review 6, 1–21.

Hsiao, C., 2014. Analysis of Panel Data. Cambridge University Press.

Jandl, J.-O., Fuerst, F., 2016. Information Supply and Demand in Securitized Real Estate Markets [WWW Document]. https://doi.org/10.13140/rg.2.1.2930.2803.

Ke, Q., 2015. What affects the discount to net asset value in the UK-listed property companies? Journal of Property Research 32, 240–257. https://doi.org/10.1080/09599916.2015.1045542.

Lee, N.J., Sing, T.F., Tran, D.H., 2013. REIT Share Price and NAV Deviations: Noise or Sentiment? International Real Estate Review 16, 28–47.

Lewellen, J., 1999. The time-series relations among expected return, risk, and book-to-market. Journal of Financial Economics 54, 5–43.

Lioui, A., Maio, P., 2014. Interest Rate Risk and the Cross Section of Stock Returns. Journal

of Financial and Quantitative Analysis 49, 483–511. https://doi.org/10.1017/S0022109014000131.

Liow, K.H., 2003. Property Company Stock Price and Net Asset Value: A Mean Reversion Perspective. Journal of Real Estate Finance and Economics 27, 235–255. https://doi.org/10.1023/A:1024780404907.

Liow, K.H., Li, Y., 2006. Net Asset Value Discounts for Asian-Pacific Real Estate Companies: Long-Run Relationships and Short-Term Dynamics. Journal of Real Estate Finance and Economics 33, 363. https://doi.org/10.1007/s11146-006-0338-z.

Morri, G., Baccarin, A., 2016. European REITs NAV discount: Do investors believe in property appraisal? Journal of Property Investment & Finance 34, 347–374. https://doi.org/10.1108/JPIF-09-2015-0068.

Morri, G., Benedetto, P., 2009. Leverage and NAV discount: Evidence from Italian real estate investment funds. Journal of European Real Estate Research 2, 33–55. https://doi.org/10.1108/17539260910959545.

Morri, G., McAllister, P., Ward, C., 2005. Explaining deviations from NAV in UK property companies: Rationality and sentimentality (Report No. 20/05). University of Reading, Reading.

Mueller, M.G., Pfnuer, A., 2013. A Review of the Noise Trader Model Concerning the NAV Spread in REIT Pricing: Evidence from the Pan EU REIT Market. Journal of Real Estate Portfolio Management 19, 189–206. https://doi.org/10.2307/24885539.

Nellessen, T., Zuelch, H., 2011. The reliability of investment property fair values under IFRS. Journal of Property Investment & Finance 29, 59–73. https://doi.org/10.1108/14635781111100209.

Patel, K., Pereira, R.A.M.G., Zavodov, K.V., 2009. Mean-Reversion in REITs Discount to NAV & Risk Premium. Journal of Real Estate Finance and Economics 39, 229–247. https://doi.org/10.1007/s11146-009-9185-z.

Rehkugler, H., Schindler, F., Zajonz, R., 2012. The net asset value and stock prices of European real estate companies. Z Betriebswirtsch 82, 53–77. https://doi.org/10.1007/s11573-011-0528-x.

Woltering, R.-O., Weis, C., Schindler, F., Sebastian, S., 2018. Capturing the value premium – Global evidence from a fair value-based investment strategy. Journal of Banking & Finance 86, 53–69. https://doi.org/10.1016/j.jbankfin.2017.06.009.

Yavas, A., Yildirim, Y., 2009. PLEASE ADD REFERENCE.

Yavas, A., Yildirim, Y., 2011. Price Discovery in Real Estate Markets: A Dynamic Analysis. Journal of Real Estate Finance and Economics 42, 1–29. https://doi.org/10.1007/s11146-009-9172-.

7 Tables

Table 1: Summary Statistics

Variable	Mean	Median	Std. Dev.	Min	Max	N
$NAV\ Spread_{i,t}$	0.20	0.03	0.92	-1.00	10.00	24,336
$SIZE_{i,t}$ (in bn)	3.91	1.71	8.87	0.00	188.70	21,807
$LEV_{i,t}$	0.46	0.48	0.18	0.00	2.09	22,564
$ICR_{i,t}$	6.64	2.24	45.89	-261.67	1581.48	22,727
$BETA_{i,t}$	0.79	0.90	11.72	-914.73	81.94	23,793
$DEF_{j,t}$	1.96	1.21	2.48	-0.94	22.81	24,336
$TERM_{j,t}$	0.66	0.55	1.09	-2.43	3.56	24,336
$PTB\_ctr_{j,t}$	1.97	1.95	0.52	0.83	2.98	24,336
$PEr\_ctr_{j,t}$	14.48	14.10	4.32	5.10	36.90	24,336
$Sector\_Spr_{j,t}$	0.68	0.05	4.84	-0.73	72.94	24,336
$NAVgrowth_{i,t}$	0.32	0.02	18.36	-0.97	1330.19	21,014
$TAXRt_{i,t}$	20.07	1.67	275.75	0.00	9753.11	15,097
$BA\_Spr_{i,t}$	0.12	0.32	58.64	-7069.64	45.22	14,547
$PEratio_{i,t}$	53.16	22.90	220.14	0.70	7816.00	13,714

This table contains the summary statistics of NAV spreads and idiosyncratic and systematic factors for the global sample of listed real estate stocks over the 2005:01 to 2014:05 period. All statistics are based on monthly data.

Table 2: Cross-Correlations

	$NAV\ Spread_{i,t}$	$SIZE_{i,t}$	$LEV_{i,t}$	$ICR_{i,t}$	$BETA_{i,t}$	$DEF_{j,t}$	$TERM_{j,t}$	$PTB\_ctr_{j,t}$	$PEr\_ctr_{j,t}$	$Sector\_Spr_{j,t}$	$NAV\ grow._{i,t}$	$TAXRt_{i,t}$	$BA\_Spr_{i,t}$	$PE\ ratio_{i,t}$
$NAV\ Spread_{i,t}$	1.00													
$SIZE_{i,t}$	0.01	1.00												
$LEV_{i,t}$	0.16***	-0.04***	1.00											
$ICR_{i,t}$	0.02***	0.01	-0.16***	1.00										
$BETA_{i,t}$	-0.00	-0.05***	0.10***	-0.04***	1.00									
$DEF_{j,t}$	-0.14***	0.06***	-0.14***	0.00	0.02**	1.00								
$TERM_{j,t}$	-0.00	-0.03***	0.01	0.02***	0.00	-0.02***	1.00							
$PTB\_ctr_{j,t}$	0.06***	-0.06***	0.15***	-0.02***	0.02*	-0.26***	-0.43***	1.00						

$PEr\_ctr_{j,t}$	0.31***	0.02**	0.03***	0.03***	-0.01	-0.41***	0.10***	0.02**	1.00					
$Sector\_Spr_{j,t}$	0.20***	0.02**	0.03***	0.01	-0.00	-0.10***	0.01	-0.06***	0.21***	1.00				
$NAV\ growth_{i,t}$	-0.00	-0.00	-0.00	0.00	0.00	-0.01	-0.01	-0.01	0.03***	0.00	1.00			
$TAXRt_{i,t}$	0.04***	-0.01	0.06***	-0.01	-0.01	0.00	-0.03***	0.02**	0.02*	0.01	-0.00	1.00		
$BA\_Spr_{i,t}$	-0.01	-0.00	0.00	-0.00	-0.00	0.01	0.01	-0.02	-0.00	0.00	-0.00	0.00	1.00	
$PEratio_{i,t}$	-0.01	-0.00	0.07***	-0.02	-0.01	-0.04***	0.01	0.09***	-0.01	-0.01	-0.02**	0.24***	0.00	1.00

This table shows the correlation coefficients among NAV spreads and among idiosyncratic and systematic factors for the global sample of listed real estate stocks over the 2005:01 to 2014:05 period. All statistics are based on monthly data.

Table 3: Panel regression results | main model with large observation sample

	(1)	(2)	(3)	(4)
$SIZE_{i,t}$	0.04***	0.03***	0.03***	0.03***
	(18.84)	(16.89)	(14.06)	(17.59)
$LEV_{i,t}$	0.49***	0.65***	0.48***	0.57***
	(8.13)	(10.59)	(7.73)	(9.72)
$ICR_{i,t}$	0.06**	0.05*	0.07***	0.04*
	(2.87)	(2.33)	(3.45)	(2.14)
$BETA_{i,t}$	-0.04***	-0.02***	-0.03***	-0.03***
	(-7.38)	(-4.23)	(-6.35)	(-5.74)
$\Delta DEF_{j,t}$	-4.30***	-1.08*	-1.85***	-3.13***
	(-8.21)	(-2.04)	(-3.43)	(-6.11)
$\Delta TERM_{j,t}$	-1.95	-3.68**	-7.85***	-0.59
	(-1.44)	(-2.68)	(-5.59)	(-0.45)
$PTB\_ctr_{j,t-1}$	0.53***			0.40***
	(46.67)			(32.85)
$PEr\_ctr_{j,t-1}$		0.05***		0.03***
		(39.75)		(25.38)
$Sector\_Spr_{j,t-1}$			0.02***	0.02***
			(22.48)	(20.43)
Constant	-1.16***	-0.94***	-0.11***	-1.44***
	(-30.64)	(-25.23)	(-3.36)	(-36.74)
Observations	20768	20768	20768	20768
Adjusted R^2	0.099	0.075	0.027	0.143

This table contains the regression results for the main model. The dependent variable is the monthly NAV spread. The independent variables are the four idiosyncratic and five systematic variables. Models (1)-(3) present the stepwise inclusion of the three sentiment proxies. Model (4) is the final main model

with the entire set of factors according to formula (2). The panel regression models are estimated using fixed effects. T-statistics are in parentheses. ***, **, and * denote significance at the 0.1%, 1%, and 5% levels, respectively.

Table 4: Panel regression results | control model with small observation sample

	(1)	**(2)**	**(3)**	**(4)**
$SIZE_{i,t}$	0.03***	0.03***	0.02***	0.03***
	(14.38)	(12.76)	(9.08)	(13.30)
$LEV_{i,t}$	0.65***	1.00***	0.79***	0.78***
	(7.46)	(11.22)	(8.32)	(9.18)
$ICR_{i,t}$	0.10	0.06	0.20**	0.03
	(1.81)	(0.99)	(3.23)	(0.58)
$BETA_{i,t}$	-0.06***	-0.02**	-0.04***	-0.04***
	(-7.56)	(-2.84)	(-4.67)	(-5.88)
$\Delta DEF_{j,t}$	-3.70***	0.03	-0.89	-2.39***
	(-5.28)	(0.05)	(-1.18)	(-3.53)
$\Delta TERM_{j,t}$	2.34	1.11	-0.45	2.73
	(1.28)	(0.59)	(-0.23)	(1.55)
$PTB\_ctr_{j,t-1}$	0.60***			0.43***
	(40.06)			(27.04)
$PEr\_ctr_{j,t-1}$		0.06***		0.04***
		(35.00)		(21.83)
$Sector\_Spr_{j,t-1}$			0.02***	0.01***
			(15.35)	(13.63)
$NAVgrowth_{i,t}$	-0.18***	-0.15***	-0.14***	-0.18***
	(-10.88)	(-8.80)	(-7.56)	(-10.84)
$\Delta TAXRt_{i,t}$	-0.00	0.00	0.00	-0.00
	(-0.30)	(0.44)	(0.41)	(-0.06)
$BA\_Spr_{i,t}$	-0.00	-0.00	-0.00	-0.00
	(-0.23)	(-0.53)	(-0.54)	(-0.33)

$PEratio_{i,t}$	0.00	0.00	0.00	0.00
	(1.78)	(1.08)	(1.93)	(1.25)
Constant	-1.26***	-1.11***	-0.15**	-1.54***
	(-25.06)	(-21.92)	(-3.25)	(-30.23)
Observations	8309	8309	8309	8309
Adjusted R^2	0.175	0.142	0.040	0.236

This table contains the regression results for the control model with the small observation sample. The dependent variable is the monthly NAV spread. The independent variables are the nine variables of the main model and further four control variables. Models (1)-(3) present the stepwise inclusion of the three sentiment proxies. Model (4) is the final control model with the entire set of factors according to formula (3). The panel regression models are estimated using fixed effects. T-statistics are in parentheses. Coefficients marked with ***,**, and * are significant at the 0.1%, 1% and 5% levels, respectively.

Table 5: Panel regression results | main model | subpanels 1 and 2

	SUBPANEL 1: REIT STATUS		***SUBPANEL 2: REGIONS***		
	(1)	(2)	(1)	(2)	(3)
	REITs	REOCs	Europe	North America	Asia
$SIZE_{i,t}$	0.03***	0.06***	0.03***	0.03***	0.03***
	(16.29)	(7.95)	(5.66)	(9.99)	(11.82)
$LEV_{i,t}$	0.73***	0.25*	0.49***	1.27***	0.21
	(11.11)	(1.96)	(5.93)	(16.26)	(1.44)
$ICR_{i,t}$	0.01	0.12**	0.02	-0.51**	0.03
	(0.27)	(3.04)	(1.16)	(-2.91)	(0.54)
$BETA_{i,t}$	-0.02***	**-0.04*** **	-0.03***	0.00	-0.03**
	(-3.65)	**(-3.67)**	(-4.26)	(0.18)	(-2.71)
$\Delta DEF_{j,t}$	-2.50***	**-9.39*** **	-14.09***	-9.52***	-3.32***
	(-4.89)	**(-4.42)**	(-5.98)	(-4.97)	(-5.42)
$\Delta TERM_{j,t}$	1.49	**-9.71****	**-5.61***	**-6.99*** **	**5.68***
	(1.06)	**(-2.73)**	**(-2.09)**	**(-4.04)**	**(2.08)**
$PTB\_ctr_{j,t-1}$	0.36***	**0.47*** **	0.30***	0.04*	1.05***

	(28.36)	**(14.59)**	(14.24)	(2.34)	(37.03)
$PEr\_ctr_{j,t-1}$	0.04***	0.02***	0.00	0.03***	0.02***
	(26.08)	(4.41)	(1.61)	(15.40)	(9.37)
$Sector\_Spr_{j,t-1}$	0.02***	**0.11*** **	0.48***	0.07***	0.01***
	(19.71)	**(13.75)**	(36.53)	(10.11)	(11.93)
Constant	-1.50***	-1.21***	-0.81***	-1.17***	-2.05***
	(-35.36)	(-12.42)	(-12.89)	(-20.15)	(-26.43)
Observations	16583	4185	5357	8914	6497
Adjusted R^2	0.154	0.154	0.291	0.065	0.318

This table contains the regression results for subpanels 1 and 2 in connection with the main model. The dependent variable is the monthly NAV spread. The independent variables are the four idiosyncratic variables and the five systematic variables. The panel regression models are estimated using fixed effects. T-statistics are in parentheses. ***, **, and * denote significance at the 0.1%, 1%, and 5% levels, respectively.

Table 6: Panel regression results | main model | subpanels 3 and 4

	SUBPANEL 3: SECTOR							***SUBPANEL 4: STRATEGY***	
	(1) Industrial	(2) Office	(3) Diversified	(4) Retail	(5) Residential	(6) Hotel	(7) Specialty	(1) Rental	(2) Non-Rental
$SIZE_{i,t}$	0.12***	0.01***	0.04***	0.01*	0.15***	0.26***	0.02***	0.02***	0.06***
	(10.26)	(4.98)	(10.66)	(2.29)	(11.44)	(6.39)	(5.29)	(8.92)	(16.40)
$LEV_{i,t}$	-0.15	-0.40***	0.30**	0.31**	3.65***	0.20	-0.06	0.65***	0.13
	(-1.01)	(-3.59)	(2.85)	(3.22)	(14.36)	(0.88)	(-0.54)	(11.14)	(0.70)
$ICR_{i,t}$	-0.01	1.00***	0.09**	-0.02	-1.23	-5.96***	0.53***	0.05*	0.02
	(-0.17)	(6.05)	(2.99)	(-0.78)	(-1.81)	(-4.61)	(4.47)	(2.57)	(0.25)
$BETA_{i,t}$	-0.01	-0.04***	-0.02*	-0.04***	-0.04	0.00	-0.02	-0.03***	-0.00
	(-0.76)	(-4.67)	(-1.97)	(-4.33)	(-1.73)	(0.19)	(-1.78)	(-5.67)	(-0.12)
$\Delta DEF_{j,t}$	-1.00	-2.31*	-3.03***	-3.35**	-4.85	**-16.15*** **	**-14.02*** **	-3.37***	-4.42***
	(-0.76)	(-2.11)	(-4.32)	(-3.20)	(-1.80)	**(-4.87)**	**(-4.20)**	(-4.88)	(-5.52)
$\Delta TERM_{j,t}$	-5.96	1.12	-0.45	-1.03	6.61	**-10.62***	**-9.29****	-3.79**	3.09
	(-1.62)	(0.46)	(-0.20)	(-0.48)	(1.03)	**(-2.22)**	**(-3.04)**	(-2.76)	(0.91)
$PTB\_ctr_{j,t-1}$	0.19***	0.42***	0.61***	0.25***	0.70***	-0.09	0.11***	0.23***	**1.37*** **

	(5.89)	(19.59)	(26.49)	(14.00)	(12.02)	(-1.87)	(4.25)	(19.08)	**(37.81)**
$PEr\_ctr_{j,t-1}$	0.02***	0.03***	0.03***	0.04***	0.00	0.06***	0.03***	0.03***	0.03***
	(3.71)	(13.56)	(13.20)	(19.39)	(0.42)	(10.49)	(8.04)	(19.62)	(7.90)
$Sector\_Spr_{j,t-1}$	0.02	0.01***	0.02***	0.01**	0.04***	0.01	0.04*	0.02***	0.01***
	(1.34)	(13.97)	(14.93)	(3.26)	(6.27)	(0.25)	(2.42)	(18.24)	(5.87)
Constant	-0.77***	-0.99***	-1.61***	-1.01***	-3.61***	-0.96***	-0.38***	-1.06***	-2.75***
	(-6.90)	(-14.61)	(-24.84)	(-15.12)	(-17.38)	(-4.95)	(-4.13)	(-26.19)	(-25.34)
Observations	1400	3479	6964	4049	2303	1257	1907	16748	3854
Adjusted R^2	0.139	0.289	0.229	0.160	0.171	0.127	0.076	0.083	0.434

This table contains the regression results for subpanels 3 and 4 in connection with the main model. The dependent variable is the monthly NAV spread. The independent variables are the four idiosyncratic variables and the five systematic variables. The panel regression models are estimated using fixed effects. T-statistics are in parentheses. ***, **, and * denote significance at the 0.1%, 1%, and 5% levels, respectively.