Real Estate Value and Growth Stocks – Evidence from Global Capital Markets

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Chapter 1

Introduction

Over the past few decades, real estate as an investment has evolved into an integral part of the asset allocation of institutional and private investors. The popularity of real estate can be attributed to projectable rental income, tangibility, and the ability to actively influence performance through active asset and property management. Further advantages include the assumed inflation hedging potential and a low correlation with other asset classes. In spite of these benefits, however, investors in direct real estate face hurdles in regard to high lot sizes and investment volumes, as well as relatively high transaction, management, and information costs. A key characteristic of direct real estate is its limited liquidity, or limited ability to quickly sell the investment without a price discount to current value.

To overcome these restrictions, however, investors can pursue an indirect form of real estate investment. Underlying properties are held by a financial intermediary who issues shares of a vehicle that owns a diversified pool or portfolio of underlying real estate assets. Indirect investment thus enables an investor to participate in the performance of a diversified real estate portfolio with a relatively small amount of money. The most established types of these vehicles are open- and closed-end real estate funds and real estate stocks.

This dissertation focuses on the second type: real estate stocks, which can be categorized further as either real estate operating companies (REOCs), or real estate investment trusts (REITs). REOC shares are traded on public stock exchanges. Their business model usually includes the ownership, trading, or development of income-generating real estate assets. REITs pursue a similar business model, with the primary difference being that they have a special legal status that mandates certain requirements in their domiciled regime. For example, REITs must invest a minimum (e.g., 75%) of total assets in real estate, they must derive a minimum (e.g., 75%) of gross income from real estate activities, and they must distribute a certain percentage (e.g., 90%) of taxable income to investors as dividends. In return, REITs enjoy certain tax privileges (e.g., they are exempt from income taxes at the trust level). However, REIT regulations differ by national regime (e.g., leverage restrictions, minimum free float requirements). In contrast, REOCs are usually less regulated, and can therefore be much more flexible in their business operations.

Since 2001, the market capitalization of global REOCs and REITs has tripled, for an increase of approximately 6.6% per year (CAGR).[1] In contrast to direct real estate or mutual funds, investors in real estate stocks benefit from high levels of liquidity and transparent pricing. REOCs and REITs are usually traded on a stock exchange, so investors can immediately buy and sell their stocks. However, this benefit comes with the risk of price volatility. When new information emerges on the market, investors adjust their subjective market expectations, and stock prices follow suit accordingly. In some cases, the adjustments may be excessive and appear irrational and unjustified. Thus, what is an advantage on the one hand can be a disadvantage on the other, because stock prices can fluctuate more intensely than prices of other forms of indirect or direct real estate investments.

One idiosyncrasy that real estate stock investors face is the observed deviation of fundamental real estate values from the market stock price of a REOC or REIT. The fundamental value of real estate stocks is usually represented by net asset value (NAV), which is the value of the total assets minus the REOC's or REIT's liabilities. Between 1989 and 2018, the median discount to NAV of European real estate stocks was -11.4% with a standard deviation of 11.5%, ranging from -46.86% to 20.57% (on an aggregate index level).[2] The deviation between NAV and the stock price is referred to as the *NAV spread*, which can occur as a positive deviation, expressing a premium to NAV, or a negative deviation, expressing a discount to NAV.

It is in the observed nature of stock prices to be volatile and to fluctuate around their fundamental values. However, given Fama's (1970) efficient market hypothesis (EMH), financial markets should "*at any time 'fully reflect' all available information*."[3] This includes the intrinsic value of a company. To the extent that NAVs are a robust measure of underlying asset value, large and persistent deviations would not be justified. This phenomenon is called a "puzzle" in the literature, since research still lacks a comprehensive and universal explanation for NAV spreads.

In the financial literature, the deviation between fundamental value and stock prices has been the subject of numerous scientific discussions and studies. In this regard, the literature

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[1] This refers to the market capitalization of the FTSE EPRA/NAREIT Global Developed Index, adjusted for index constituent changes. The historic index market capitalization according to EPRA is approximately as follows: 2001: €320 bn (€1.3 bn per constituent)/2017: €1,224 bn (€3.6 bn per constituent).

[2] European Public Real Estate Association, "FTSE EPRA/NAREIT Indices Discount to NAV."

[3] Shiller (1981), however, contradicts the EMH by documenting that a substantial portion of stock volatility is unexplained by changes in fundamental information (e.g., future dividends). Another seminal theory, the capital asset pricing model (CAPM) of Sharpe (1964) and Lintner (1965), fails to describe such return anomalies. These anomalies include, e.g., that market portfolios do not entirely explain the relevant risk in the economy to expected returns (Lewellen, 1999), such as overreactions to new financial information (De Bondt and Thaler, 1985).

distinguishes between the two types *value stocks* and *growth stocks*. By definition, value stocks have a low ratio of price to fundamental value, indicating an undervaluation of the company by the stock market. In contrast, growth stocks have a high ratio of price to measures of fundamental value such as earnings or book value, which is often rationalized by a higher anticipated growth potential.

Regarding real estate stocks, NAV is a good proxy for fundamental value. In the case of listed real estate companies, whose cash flows are heavily dependent on rental income, the assets consist primarily of regularly appraised properties. Assuming other assets and liabilities are also reported close to market value, the NAV of real estate stocks can be seen as a "sum of the parts" valuation of the company. That is, each property is appraised using property-specific risk-adjusted discount rates. This provides a unique platform from which to study deviations between market prices and fundamental values across countries.

In this dissertation, I sort REOCs and REITs according to their monthly NAV spreads and form three portfolios. The *value portfolio* is the quintile of stocks with the highest discount to NAV, while the middle three quintiles are defined as the *middle portfolio*, and the *growth portfolio* is the quintile of stocks with the highest premium to NAV.

This classification generally relates to the definition of REOCs and REITs traded at the highest discounts to NAV as "real estate value stocks," and those traded at the highest premiums to NAV as "real estate growth stocks."

From the scholarly debates and publications of the financial and real estate literature of the last decades, two essential questions regarding value and growth stocks have crystallized:

1) Do value stocks outperform growth stocks in the long run?

2) Which factors lead to the deviations in stock prices and fundamental values?

The three papers of this dissertation pivot around these two research questions and aim to fill a gap in the real estate literature.

With the first paper ("*Capturing the value premium – global evidence from a fair value-based investment strategy")*, my co-authors and I address the key question of whether real estate value stocks outperform real estate growth stocks in the long run. This paper builds the first part of the dissertation, and examines the risk premium of value stocks within a global listed real estate investment strategy framework. We explore whether an investment strategy of systematically buying real estate value stocks and shorting real estate growth stocks generates an outperformance. My co-authors and I test this by using fair value-based net asset values (NAVs) as our proxies for fundamental value.

Our study is based on a sample of 255 real estate stocks in 11 countries with fair value-based accounting regimes over the 2005-2014 period. Our empirical approach follows a monthly trading strategy. At the end of each month, we rank all stocks according to their deviations from NAV. We then form three portfolios whose returns are observed over the following month. The focus is on the value portfolio, defined as the quintile of stocks with the highest discount to NAV. After portfolio formation, we compare the risk-return characteristics based on absolute returns and use time series regressions to evaluate the risk-adjusted performance. We find that systematically investing in real estate value stocks in a country is the key to achieving an outperformance. The annualized excess return of the global value portfolio sorted according to relative mispricing is 10.0%, which remains significant after controlling for common risk factors.

With the second paper (*"New insights into the NAV spread puzzle of listed real estate: idiosyncratic and systematic evidence"),* my co-author and I address the second key question. We examine which factors cause the NAV spreads that are essential for the classification as either a real estate value stock or a real estate growth stock. The empirical analysis includes a global panel regression model based on 447 listed real estate companies (337 REITs and 110 REOCs) in 12 countries over the 2005-2014 period. We contribute to the literature by controlling for both idiosyncratic and systematic factors in a NAV spread context. The results show that company size, stock market risk, leverage, cost of debt, and real estate sentiment are important factors that can explain the deviations between stock prices and NAV. Moreover, we present four new innovative factors in this study: the interest coverage ratio, the default and term spread as interest rate proxies, and marketwide (non-real estate) sentiment. These factors obviously help explain the NAV spread puzzle and update existing research.

From the results of the second paper, what stands out is the obvious role of the credit market, especially interest rates, in a listed real estate context. Because of their unique characteristics, listed real estate companies are assumed to be prone to interest rate changes. The last part and third paper of my dissertation ties in this theory.

With the third paper (*"The interest rate sensitivities of value and growth stocks: evidence from listed real estate companies"),* my co-authors and I analyze whether the returns of real estate value and growth stocks react differently to changes in various interest rate proxies. We hypothesize that there are three *channels* through which interest rates may impact the stock market returns of listed real estate companies: 1) the relative attractiveness of real estate stocks compared to 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*). However, to date there has been no significant study that relates interest rate risk to real estate value or growth stocks. Due to their different characteristics, we assume that value and growth stocks react differently to changes in different types of interest rates. For example, changing long-term interest rates should have a relatively stronger impact on the present value of the future cash flows of growth stocks. This is because their future cash flows are discounted at a higher rate that is induced by long-term interest rates.

This paper fills in this research gap: we systematically analyze whether, and to what extent, the performance of real estate value and growth stocks can be explained by changes in five different interest rate proxies: short-term interest rates (STIR), long-term interest rates (LTIR), term spreads (TERM), corporate bond yields (CBY), and default spreads (DEF). We find that value stocks are more sensitive to changes in the short-term interest rate, the corporate bond yield, and the default spread. In contrast, growth stocks are more sensitive to changes in long-term interest rates and the term spread.

To the best of our knowledge, this paper is the first to examine the diverging interest rate sensitivities of real estate value and growth stocks. Furthermore, this is the first paper to address interest rate sensitivities in a NAV context based on a global setting, and to contribute to answering the second key question, "*which factors lead to the deviations in stock prices and fundamental value?*"

Chapter 2

Capturing the value premium – global evidence from a fair value-based investment strategy

This paper is the result of a joint project with René-Ojas Woltering, Felix Schindler, and Steffen Sebastian. It was published in the Journal of Banking & Finance, Vol. 86 (2018), pp. 53-69.

Abstract

This paper examines the risk premium of value stocks within a global investment strategy framework. We test whether absolute or relative mispricing is better suited to capturing the global value premium by using fair value-based net asset values (NAVs) as our proxies for fundamental value. We find that investing in the most underpriced stocks relative to the average ratio of price to fundamental value in a country is the key to achieving superior risk-adjusted returns. The annualized excess return of the global value portfolio sorted according to relative mispricing is 10.0%, and remains significant after controlling for common risk factors.

2.1 Introduction

Numerous studies show that value stocks (those with a low ratio of price to fundamental value) on average outperform growth stocks, both for the U.S. (Rosenberg et al., 1985; Fama and French, 1992) and international stock markets (Fama and French, 2012; Asness et al., 2013). The literature exhibits some discrepancies regarding how to interpret the value premium. Proponents of the efficient market hypothesis argue it is compensation for higher risk (e.g. Davis et al., 2000), while others attribute the return anomaly to suboptimal investor behavior (e.g. Lakonishok et al., 1994; De Bondt and Thaler, 1985). However, the commonality among these studies is that they separate value and growth stocks according to their book-to-market ratios of equity. Thus, whether explicitly or implicitly, the book value of equity is used as the proxy for a firm's fundamental or intrinsic value.

Most academics agree that a firm's intrinsic value is determined primarily by the present value of its future cash flows, which is not necessarily reflected by balance sheet data. Therefore, if viewed as a rather poor proxy for mispricing, the robust outperformance of stocks with high book-to-market ratios of equity appears somewhat surprising. It also raises the question of how returns are distributed when a more reliable proxy for intrinsic value is used. For example, Lee et al. (1999) use a residual income valuation approach to determine the intrinsic value of the Dow Jones Industrial Average, and find it has much higher explanatory power than the aggregate book-to-market ratio. This study focuses on a sample of stocks for which we believe the book value of equity is actually a good proxy for intrinsic value: property-holding companies in countries with fair value-based accounting regimes.

The introduction of the International Financial Reporting Standards (IFRS) led to a paradigm change in many countries. In general, IFRS increased the comparability of accounting data across countries, thus reducing investors' information costs (Ball, 2006). In contrast to historical cost-based accounting regimes, IFRS accounting emphasizes reporting assets at their fair value. In the case of property-holding companies, whose cash flows are heavily dependent on rental income, the assets consist primarily of regularly appraised property values. Presuming 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 the company, where each property is appraised using property-specific risk-adjusted discount rates. This provides a unique setting to study discrepancies between market prices and estimates of intrinsic value across countries.

Overall, our sample consists of 255 listed property holding companies in 11 countries over the 2005–2014 period.

Our objectives are (1) to examine the relationship between price and value at an individual country level using NAV as the proxy for intrinsic value, and, more importantly, (2) to explore whether mispricings across countries can be exploited to generate risk-adjusted excess returns by investing in a globally diversified value portfolio. The underlying rationale is that NAV deviations are temporary, and mean reversion will ultimately cause prices to return to their intrinsic values. Another potential source of diversification may arise from less than perfect cross-country correlations of the risk factors that can cause NAV discrepancies across countries.

Our empirical approach is based on a monthly trading strategy. At the end of each month, we rank all stocks according to their deviations from intrinsic value, as measured by the NAV spread. We then form three portfolios whose returns are observed over the following month, with the focus being on the value portfolio, which is defined as the quintile of stocks with the highest discount to NAV.

We examine value investment strategies at both an individual country level and a global level. At the global level, we compare two approaches. First, we follow the country-level approach and form portfolios according to their absolute discounts to NAV. However, one drawback with this approach is that the global value portfolio may be overly exposed to country risk. Thus, if an entire country is trading at depressed levels relative to other countries, the global value portfolio may even include growth stocks of the discount country, which would nullify any potential diversification gains from within-country mean reversion.

Second, we control for such country effects by sorting stocks according to their relative NAV discounts (e.g., with respect to a country's average NAV discount in a given month). A comparison of both approaches enables us to determine whether absolute or relative deviations from NAV are better suited to exploit security mispricings across countries. To this end, after portfolio formation, we compare the risk-return characteristics based on absolute returns before using time series regressions to evaluate risk-adjusted performance.

We find that value portfolios strongly outperform their benchmarks in most countries, but they are also more risky, as indicated by higher return volatility, higher loadings with respect to systematic risk factors, and significant risk-adjusted returns in only two out of eleven countries. The results improve considerably at a global level, especially when country-specific effects are taken into account (i.e., when the portfolios are sorted according to relative NAV spreads). The annualized excess return of the global value portfolio is 10.0%, based on country-adjusted NAV discounts, and it is 7.4% based on absolute NAV discounts. At the same time, the value portfolio, which is based on country-adjusted NAVs, is also less risky by all measures, and it produces significant risk-adjusted returns. Overall, our findings suggest that relative mispricing is better suited to capture the global value premium, at least in the short term.

The remainder of this paper is organized as follows. Section 2.2 reviews the related literature and introduces our hypotheses. The methodology, data, and descriptive statistics are described in Section 2.3. Section 2.4 provides the empirical results, and Section 2.5 concludes.

2.2 Related literature and hypotheses

2.2.1 Value stocks and risk

The literature has long been dominated by the view that financial markets are efficient, or, in other words, that price equals intrinsic value at all times. Early academic opponents of this view include Shiller (1981), who finds that stock price volatility appears to be too high to reflect changes in fundamental information; Shiller et al. (1984), who argue that stock prices are subject to fads and fashions that can result in overreactions to new financial information; De Bondt and Thaler (1985), who provide empirical evidence for the overreaction hypothesis by documenting how portfolios of past losers outperform past winners; and Rosenberg et al. (1985), who find that stocks with high book-to-market ratios of equity have higher returns than those with low ratios. Because these return patterns cannot be described by the capital asset pricing model (CAPM) of Sharpe (1964) and Lintner (1965), they are referred to as return anomalies.

Fama and French (1992) address these shortcomings by extending the CAPM by two further factors: size and book-to-market. They find that the three-factor model is better at explaining stock returns. Assuming that assets are priced rationally, the authors argue that the book-to-market factor is a proxy for undiversifiable risk. However, this view has been criticized by Daniel and Titman (2006), for example, who argue that the Fama-French model "is designed to explain the book-to-market effect." Ferson et al. (1999) make a similar argument, and caution that empirical regularities will appear to be useful risk factors even when their attributes are "completely unrelated to risk."

Proponents of behavioral finance argue that value strategies produce higher returns not because they are fundamentally riskier, but because they exploit suboptimal investor behavior. For example, the extrapolation theory, which goes back to Lakonishok et al. (1994). The authors posit that some investors naively extrapolate past trends into the future, thereby bidding up (down) prices to irrationally high (low) levels, which provides an opportunity for contrarian investors to earn excess returns.

On the other hand, a number of studies provide evidence in favor of the theory that the value premium is a compensation for higher fundamental risk. For example, Fama and French (1995) find that firms with a high book-to-market ratio have higher leverage ratios and tend to be distressed relative to growth stocks.

Another strand of the literature tries to explain the value premium by the conditional CAPM, which uses time-varying betas. Petkova and Zhang (2005) find that time-varying risk is indeed better suited to explain the value premium. But the authors concede that the value premium is still too large to be fully explained by the conditional CAPM.

Choi (2013) also uses a time-varying beta approach, and finds further evidence for the risk-based explanation of the value premium. He documents that the asset risk and financial leverage of value stocks are particularly likely to increase during economic downturns. However, his model leaves approximately 60% of the unconditional value premium unexplained.

Overall, the literature tends to agree that value stocks are somewhat fundamentally riskier than growth stocks. But the value premium appears too large to be explained solely as compensation for additional risk, which gives some credence to mispricing theories.

The aforementioned studies are generally based on common stocks, and, in many cases, property holding companies or REITs were deliberately excluded (e.g. Fama and French, 1992). Ooi et al. (2007) examine the value premium by using U.S. REIT data, and find that the quintile of value REITs outperforms the quintile of growth REITs by 8.5% p.a.. The authors also find support for the extrapolation theory of Lakonishok et al. (1994), because value REITs exhibit poorer returns prior to portfolio formation, but their subsequent performance tends to be better than anticipated. This results in positive earnings surprises and higher returns. We exclude U.S. REITs here, however, because their book values are based on historical costs and not on fair values, due to U.S. GAAP accounting regulations.

To the best of our knowledge, our study is the first to address the value premium in the context of fair value accounting.

The interpretation of the value premium in the context of fair value accounting is somewhat ambivalent. On the one hand, it seems straightforward to interpret price deviations from NAV as mispricings, because the NAV is supposed to be a relatively reliable proxy for intrinsic value. On the other hand, if reliable information about intrinsic value is easily available to all investors, then it seems counterintuitive that prices would depart from NAV, unless the discount is related to some risk factor.

For example, investors may not trust reported appraisal values, or they may anticipate devaluations. This could hence lead to a lower NAV when the next financial report is published. Moreover, the fact that property holding companies tend to be highly leveraged would amplify the impact of property devaluations on NAVs, potentially justifying large discounts before publication of the next report. Brounen and Laak (2005) find empirical support for such risk-based explanations of NAV discounts. In their sample of European property holding companies from 2002, a large discount to NAV is positively related to firm-specific risk factors such as high leverage or a lack of transparency.

In summary, if the book-to-market ratio is seen as a proxy for mispricing, there are good reasons to anticipate that value investment strategies will work even better when the proxy for intrinsic value is more reliable (as with the NAV of property holding companies under fair value-based accounting regimes). However, precisely because the NAV is supposed to be a relatively reliable proxy for intrinsic value which is also publicly available to all investors, deviations from intrinsic value may be explained only by risk factors that do not appear on a firm's balance sheet, such as anticipated financial distress. For example, the market may use higher discount rates on the firm's expected cash flows than property appraisers – a scenario that seems particularly likely during periods of market distress, when the price of risk is higher, as suggested by Zhang (2005). Reflecting these risk-based explanations for the NAV discounts, we formulate our first hypothesis as follows:

Hypothesis 2.1: *Discounts to NAV are at least partially attributable to risk factors that are not fully reflected on a firm's balance sheet; hence, value stocks do not produce superior returns on a risk-adjusted basis.*

2.2.2 The value premium and international diversification

Is it possible to capture the value premium with little risk by holding a diversified value portfolio? Fama and French (1993) negate this question by arguing that value stocks are subject to undiversifiable factor risk. More precisely, Fama and French (1995) argue that the book-to-market factor is a proxy for default risk or financial distress, an explanation that is particularly relevant during recessions. In line with this business cycle view, Liew and Vassalou (2000) find that the size (SMB) and book-to market (HML) risk factors are significantly related to future GDP growth, while Vassalou (2003) finds that SMB and HML lose much of their predictive power if a factor is added that contains information related to future GDP growth. Zhang (2005) provides a technological explanation for the underperformance of value stocks during recessions. He argues that, during bad times, value stocks are burdened with unproductive capital because of costly reversibility, while growth stocks can more easily scale down their expansions temporarily.

But what about the risk-return profile of value stocks beyond individual economies? Numerous studies document that the value premium is not a U.S. phenomenon, but rather a worldwide one (e.g. Fama and French, 1998; Asness et al., 2013). In case not all economies fall into recession simultaneously, the factor risk of value stocks is country-specific and hence (at least to some extent) diversifiable at a global level. However, the results of Fama and French (1998) suggest this may not be the case. Using a global two-factor model, they find that the global value premium is captured by a global factor for relative distress, which is basically an international HML factor. In contrast, Griffin (2002) finds that country-specific versions of the three-factor model offer much better explanatory power for international stock returns than a global factor model. This result suggests that the factor risk of value stocks exhibits a country-specific component that could provide an opportunity for diversification gains at the global level. This leads us to our second hypothesis:

Hypothesis 2.2: *The factor risk of value stocks has a country-specific component. Thus, superior risk-adjusted returns can be achieved by diversifying the risk of value stocks across countries.*

2.2.3 Absolute versus relative mispricing

When a global value investment strategy is implemented, the question arises of how to take advantage of potential mispricings across the international sample of value stocks. In that regard, one advantage of the real estate stock context is that the value premium can also be seen from a mean reversion perspective. If the book value of equity is a good proxy for intrinsic value, stocks should trade for a book-to-market ratio of around 1, which is equivalent to a NAV discount of 0. The most underpriced stocks, or, alternatively, those with the highest NAV discounts, are then defined as value stocks. If the NAV discount closes through share price appreciation, the value premium could be explained by the mean-reverting relationship between price and NAV.[4] Both the real estate literature (e.g. Patel et al., 2009) and the closed-end fund literature (e.g. Pontiff, 1995) provide strong evidence in favor of a mean-reverting relationship between prices and NAV.

The implications of mean reversion for the global value investment strategy are twofold. To reflect this, we empirically test two different versions of the strategy. First, assuming that all stocks trade around their intrinsic value as measured by the book value (or NAV), it seems straightforward to sort the global stock sample according to the book-to-market ratio (or discount to NAV), and invest in the most underpriced stocks according to this measure. We refer to this as the absolute mispricing strategy, because it is based on a stock's absolute discount to NAV.

However, value stocks may also "catch up" relative to growth stocks within the same country, rather than relative to their own intrinsic value. Thus, if mean reversion occurs primarily at a country level, the absolute mispricing strategy may be suboptimal. Furthermore, it is possible that all the stocks of one country may trade at a deep discount, while the stocks of other countries are trading at a large premium. In this case, the global value portfolio would comprise all the stocks of the discount country, but none of the premium countries. While this reflects the idea of absolute mispricing, it also implies that, from a country-level perspective, the global value portfolio may be composed of all the growth stocks of the discount country while excluding all the value stocks of the premium countries.

To avoid this scenario, and to account for the possibility that mean reversion occurs primarily at the country level, our second test examines an alternative global value investment strategy where all stocks are sorted according to their relative NAV discounts (i.e., their relative average NAV discounts in a country). This strategy ensures that the global value portfolio only consists of stocks that are actually considered value stocks on a within-country basis.

[4] Alternatively, the discount may also close because the market correctly anticipated decreases in NAV, which would be consistent with risk-based explanations for the value premium.

This global value portfolio subsequently invests in the most underpriced securities relative to the average level of price to fundamental value in a country.

We refer to this as the relative mispricing strategy. Reflecting its advantages, we formulate our third hypothesis, as follows:

Hypothesis 2.3: *The global value portfolio sorted according to relative mispricing outperforms the global value portfolio sorted according to absolute mispricing.*

2.3 Data, methodology, and sample description

2.3.1 Sample description and data sources

Our sample is based on the period from January 2005 to May 2014, which features a yet unparalleled degree of accounting information comparability across countries due to the introduction of IFRS in the EU and many other countries. To ensure the book value of equity is a good proxy for a firm's fundamental value, we base our sample on the FTSE EPRA/NAREIT Global Real Estate Index, which is comprised of listed equities with "relevant real estate activities." The index provider defines relevant real estate activities as "the ownership, trading and development of income-producing real estate."

Accordingly, these firms mainly derive their cash flows from income-producing assets that are shown on their balance sheets. If the accounting regime requires fair value reporting, the book value of equity can be understood as a sum of the parts valuation of the company, assuming that cash and other assets, and liabilities are also reported at their market values.[5] To ensure this is the case, we only include FTSE EPRA/NAREIT Global Real Estate Index constituents of countries that either adopted the IFRS, or whose national standards converged to or can be seen as equivalent to IFRS according to information provided on IAS Plus.[6] Our sample is based on historic index constituents, which are updated on a monthly basis, and hence unlikely to suffer from survivorship bias.

In their study of the global value premium, Fama and French (1998) only include countries for which they obtain a minimum of ten observations over the sample period. Our study focuses on only one sector, however, so we lower that minimum to more than five in order to avoid losing too many observations. Of those countries fulfilling this condition, we only exclude the U.S., because, according to U.S. GAAP, assets are generally reported at historical costs as opposed to fair value.

Our final sample consists of 255 stocks from 11 countries with fair value-based accounting regimes. Panel A of Table 2.1 reports the number of stocks by country, and the total number of country-month observations.

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[5] Of particular relevance in this study is IAS 40, which requires investment properties to be reported at fair value. IAS 40 also allows companies to report properties at historical costs, and to disclose fair values only in footnotes. However, this option is rarely implemented in actual practice. Using U.K. data, Liang and Riedl (2013) document unanimous recognition of fair values on the balance sheet, while the EY (2011) international survey shows that only three out of thirty-eight property holding companies opted for the cost model.

[6] http://www.iasplus.com.

Table 2.1: Descriptive statistics of returns and NAV spreads.

	Returns (%)		**NAV spreads (%)**		**Number of**	
	Mean	Std. Dev.	Mean	Std. Dev.	Stocks	Obs.
Panel A: Individual Stock Level						
Australia	0.20	9.55	10.76	62.99	28	1,761
Belgium	0.70	5.10	8.33	21.07	7	667
Canada	1.12	6.40	94.45	181.92	34	2,061
France	0.87	8.99	42.13	75.87	11	992
Germany	0.03	13.92	7.27	104.29	16	870
Hong Kong	1.36	13.44	27.00	114.93	31	2,186
Japan	1.08	10.36	70.08	134.38	41	2,611
Netherlands	0.65	9.16	-3.83	26.92	9	741
Singapore	1.20	9.67	15.40	65.88	21	1,413
Sweden	1.56	8.33	16.13	33.03	8	625
United Kingdom	0.56	12.50	7.02	75.66	49	3,345
Global	0.86	10.62	32.53	110.36	255	17,524
Panel B: Aggregate Index Level						
Australia	0.26	6.39	5.75	31.28	-	113
Belgium	0.74	3.73	8.57	12.91	-	113
Canada	1.09	4.47	95.70	36.85	-	113
France	0.99	6.63	44.08	27.76	-	113
Germany	0.45	10.05	24.92	92.46	-	113
Hong Kong	1.41	10.04	24.13	55.35	-	113
Japan	1.05	7.55	68.22	72.71	-	113
Netherlands	0.61	6.53	-6.10	23.16	-	113
Singapore	1.30	7.87	16.04	37.99	-	113
Sweden	1.57	7.38	17.44	25.33	-	113
United Kingdom	0.81	7.19	6.89	27.32	-	113
Global	0.93	5.51	31.73	31.18	-	113

This table contains the returns, NAV spreads, and number of observations for the global sample of real estate stocks over the January 2005 to May 2014 period. All returns are monthly and in local currencies. Panel A is at the individual stock level; panel B is at the index level, calculated as equally weighted portfolios of the numbers shown in panel A.

2.3.2 Monthly trading strategy

The majority of asset pricing studies separates value and growth stocks only once per year based on end of June data for the book-to-market ratio of equity (e.g. Fama and French, 1993). The rationale behind this procedure is to ensure that financial reporting data for the previous year are actually published and available to all investors.

However, there are two primary problems with this approach. First, any mispricing of value stocks may already be reversed before the value portfolio is formed. For example, Bernard and Thomas (1989) find that stock returns tend to drift in the direction of the earnings surprise following the earnings announcement. This is all the more a concern as earnings surprises are systematically more positive for value than growth stocks (see Porta et al., 1997). Second, it is possible that some stocks' share prices increase so much within the twelve months prior to the new portfolios being formed that they would no longer be classified as value stocks.

We avoid these shortcomings by using a monthly sorting procedure, based on Datastream's "earnings per share report date (EPS)." We can thus ensure that financial reporting data are actually published as new portfolios are formed. For example, if the annual report for calendar year 2014 is published in April 2015, Datastream will report a new book value of equity from December 2014 onward, but we can shift this information by four months by using the "earnings per share report date." Financial reporting frequency is generally semiannual and may even be quarterly. Thus, NAVs may only change semiannually, but we observe monthly changes in the book-to-market ratios due to share price fluctuations.

To take advantage of potential security mispricings across countries, we use a monthly trading strategy that invests in those stocks with the highest departures from intrinsic value as measured by their NAV discounts.[7] Sorting stocks based on NAV discounts is equivalent to sorting stocks according to their book-to-market ratios. Nevertheless, we adjust our terminology because, in our setting, stocks would be expected to trade closer to a book-to-market ratio of around 1 since the NAV is supposed to be a more reliable proxy for intrinsic value.

In terms of NAV, discounts should theoretically fluctuate around 0, where the stocks that trade at the highest discounts are referred to as value stocks. We calculate the NAV per share

[7] In additional robustness tests we use a yearly sorting procedure as in Fama and French (1993). Overall, our results are similar, but slightly weaker, using the annual sorting procedure. The comparison highlights the virtues of the monthly sorting procedure. The additional results are presented in the Appendix in Table 2.6.

(or the book value of equity) by dividing Datastream's "common equity" by "number of shares." The discount to NAV is calculated with respect to the "unadjusted share price" as reported by Datastream. Because stocks may also trade at a premium to NAV, we term our sorting criteria NAV spread:[8]

$$\text{NAV Spread}_{\text{i,t}} = \frac{\text{Price}_{\text{i,t}}}{\text{NAV}_{\text{i,t}}} - 1 \qquad \text{(Eq. 2.1)}$$

To test whether absolute or relative mispricing is better suited to capture the value premium (Hypothesis 2.3), we also form portfolios based on the NAV discount of stock i in country j relative to the average NAV discount in country j, as follows:

$$\begin{aligned}\text{Relative NAV Spread}_{i,j,t} &= \text{NAV Spread}_{i,j,t} \\ &\quad - \text{Average Country NAV Spread}_{j,t}\end{aligned} \qquad \text{(Eq. 2.2)}$$

After sorting the sample based on month-end data for both measures, we form three portfolios and observe their total returns as reported by Datastream over the following month. The value portfolio (P1) is defined as the quintile of stocks with the highest discount to NAV; the middle three quintiles are defined as the middle portfolio (P2); and the growth portfolio (P3) is defined as the quintile of stocks with the highest NAV premiums. Furthermore, we form a long-short portfolio (P1-P3), which represents an investment strategy of buying stocks that trade at the highest discounts to NAV and (short-)selling stocks with the highest NAV premiums.[9]

All portfolios are constructed using equal weights. We do not consider value-weighted returns because our sample size is rather small, and value-weighting would place undue emphasis on individual stock performance. Note also that all returns are in local currencies to ensure our results are not driven by exchange rate fluctuations.

Our approach of sorting global portfolios based on absolute or relative NAV spreads differs from that of Fama and French (1998), who use MSCI weights to construct portfolios from country-level value and growth portfolios. Our proxy for fundamental value enables us to be more granular. The comparability of NAVs across countries means we are able to form the global value portfolio according to absolute attractiveness – an approach that would hardly

[8] Note that, due to our research design, a sorting procedure based on price-to-book ratios would result in exactly the same rankings.

[9] In principle, short selling is allowed in each of the eleven countries in our sample, although temporary bans on it are unknown. However, our major empirical conclusions remain unaffected, because they are predicated on the risk-adjusted performance of long positions in the global value portfolios.

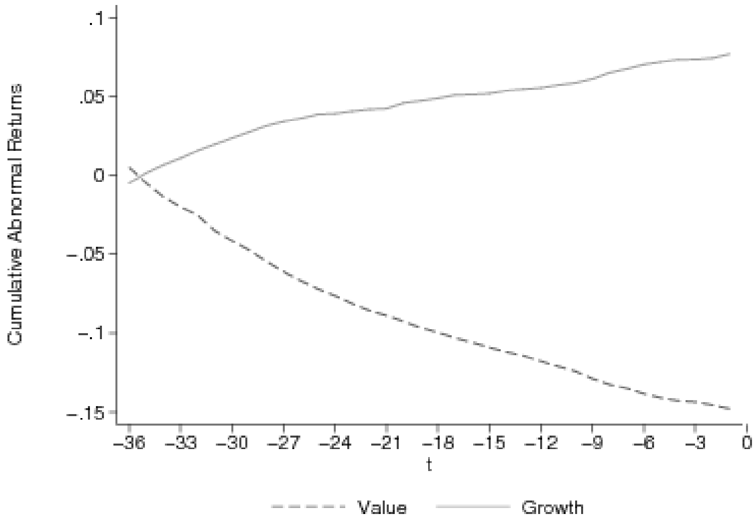
make sense in a setting with a poor proxy for fundamental value, heterogeneous industries, or divergent accounting standards.

On the other hand, the approach of Fama and French (1998) avoids the problem of having a global value portfolio that excludes other countries' value stocks, while relying too heavily on one country's growth stocks. However, their approach is not well suited to capture relative mispricing as a potential source of global diversification gains. It is again the comparability of accounting measures that enables us to identify stocks with the highest potential to catch up relative to their peers in the same country. The approach of Fama and French (1998) can be understood as a compromise between our two extremes.

2.3.3 Portfolio characteristics

This subsection provides some insights into the pre-portfolio formation performance of value and growth stocks, average NAV spreads by country, and the country-level diversification of the two global value portfolios. Figure 2.1 shows the cumulative abnormal performance of value and growth stocks for the thirty-six months leading up to portfolio formation. The dotted line shows that value stocks on average underperform their country-specific benchmark by -14.8%; the solid line shows that growth stocks on average gain 7.7%. This suggests that NAV spreads are an effective measure for delineating between value and growth stocks.

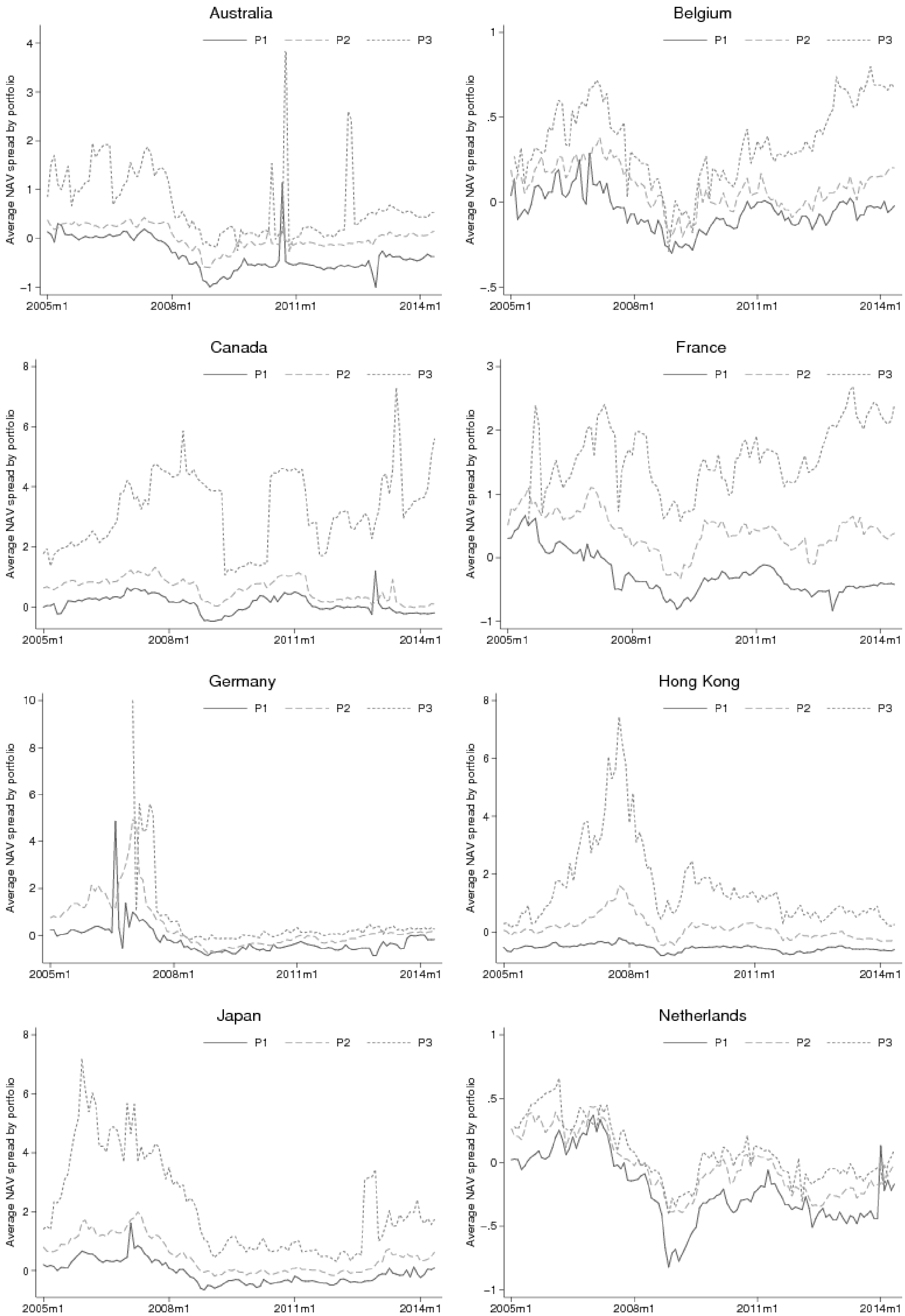
Figure 2.1: Performance of value and growth before portfolio formation.



This figure shows the cumulative abnormal performance of value and growth stocks during the thirty-six months prior to portfolio formation. The solid line shows the performance for growth stocks; the dashed line shows the performance for value stocks.

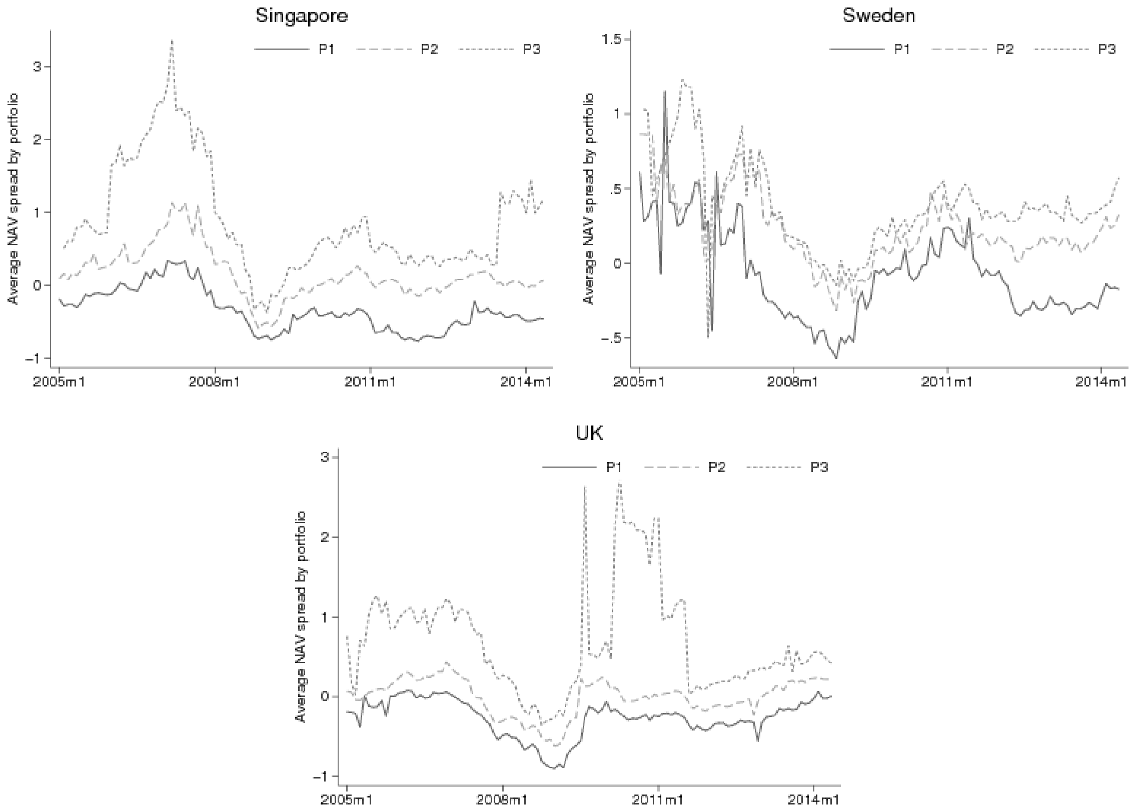
Figure 2.2 shows the average NAV spreads by country, differentiating among the value, mid, and growth portfolios. The graphs reveal a substantial degree of variation of average NAV spreads across time and across countries. Note that, particularly in the months prior to the financial crisis, there are pronounced differences between the average NAV spreads for the value and growth portfolios of Canada, Hong Kong, Japan, and Singapore. Hence, these countries should be relatively highly weighted within the global value portfolio based on relative mispricing, even though value stocks from other countries may have larger NAV discounts on an absolute basis. Interestingly, the differences between the spreads in most countries tended to shrink during the financial crisis. This suggests that growth stocks experience a relatively stronger loss from repricing than value stocks, which fall from a much lower price level. Another argument in favor of the relative mispricing strategy stems from the observation that there are periods when growth stocks actually trade at a discount to NAV. This is the case in Australia, Belgium, the Netherlands, Singapore, Sweden, and the U.K. during the financial crisis. Hence, these stocks may be part of the global value portfolio based on absolute NAV spreads, although they are not cheap on a within-country basis.

Figure 2.2: Average NAV spreads by country and portfolio.



(continued on next page)

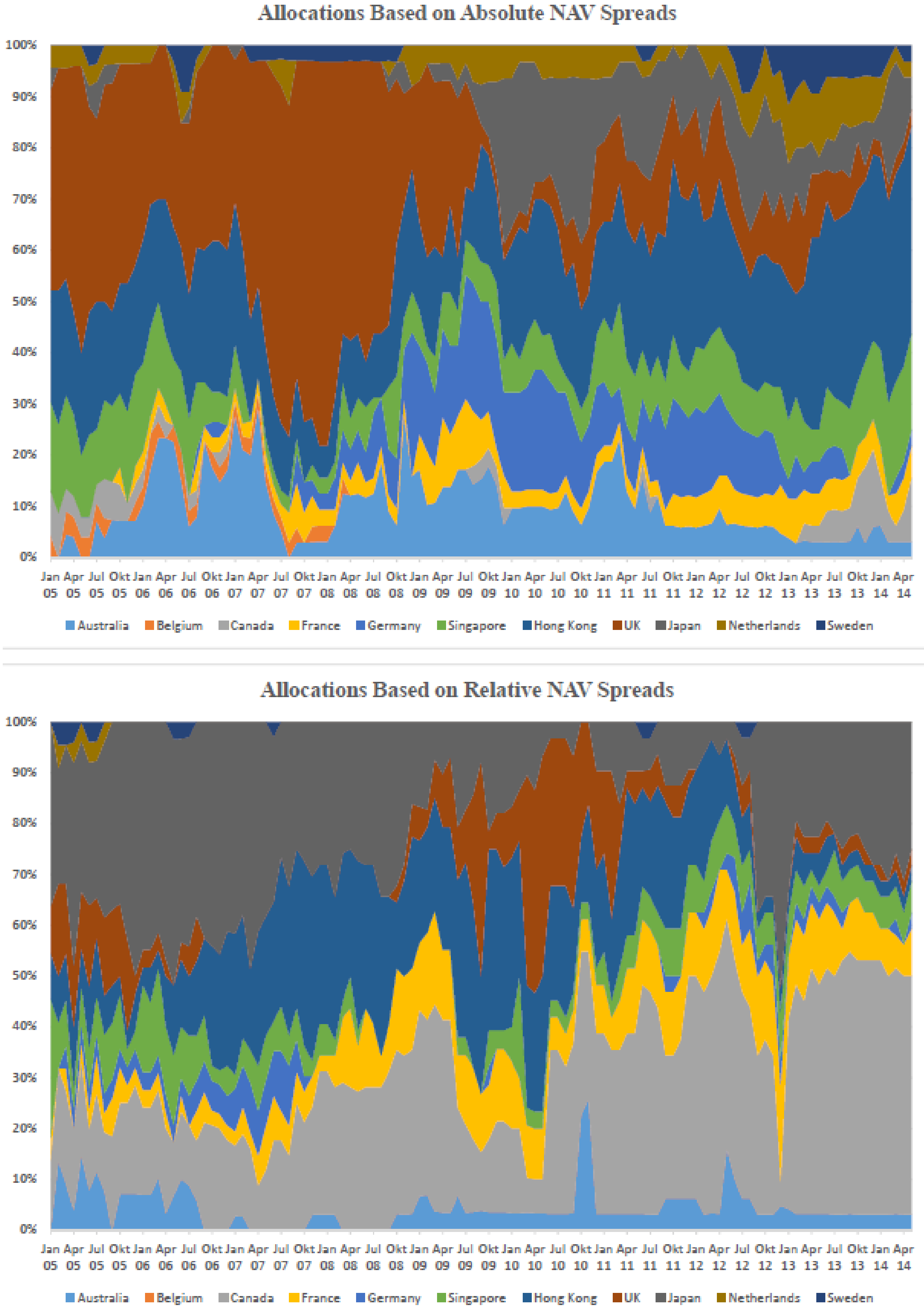
Figure 2.2 *(continued)*



This figure (figure 2.2) shows the average NAV spreads by country and portfolio over the January 2005 to May 2014 period. All (log) returns are monthly and in local currencies. The P1 portfolio consists of the quintile of stocks with the highest NAV discounts in a given month; the P2 portfolio consists of stocks in the middle three quintiles of stocks sorted according to their NAVs; and the P3 portfolio consists of stocks with the highest NAV premiums in a given month.

Figure 2.3 gives the portfolio allocations by country for the two global value portfolios. It is immediately evident that the holdings of both portfolios differ substantially from each other. During the first half of the sample period, the global value portfolio based on absolute NAV spreads was dominated by U.K. stocks, with up to 75% in January 2008. As Figure 2.2 shows, this is because U.K. value stocks obtain the steepest discount to NAV compared to all other countries.

Figure 2.3: Portfolio allocations by country for global value portfolios.

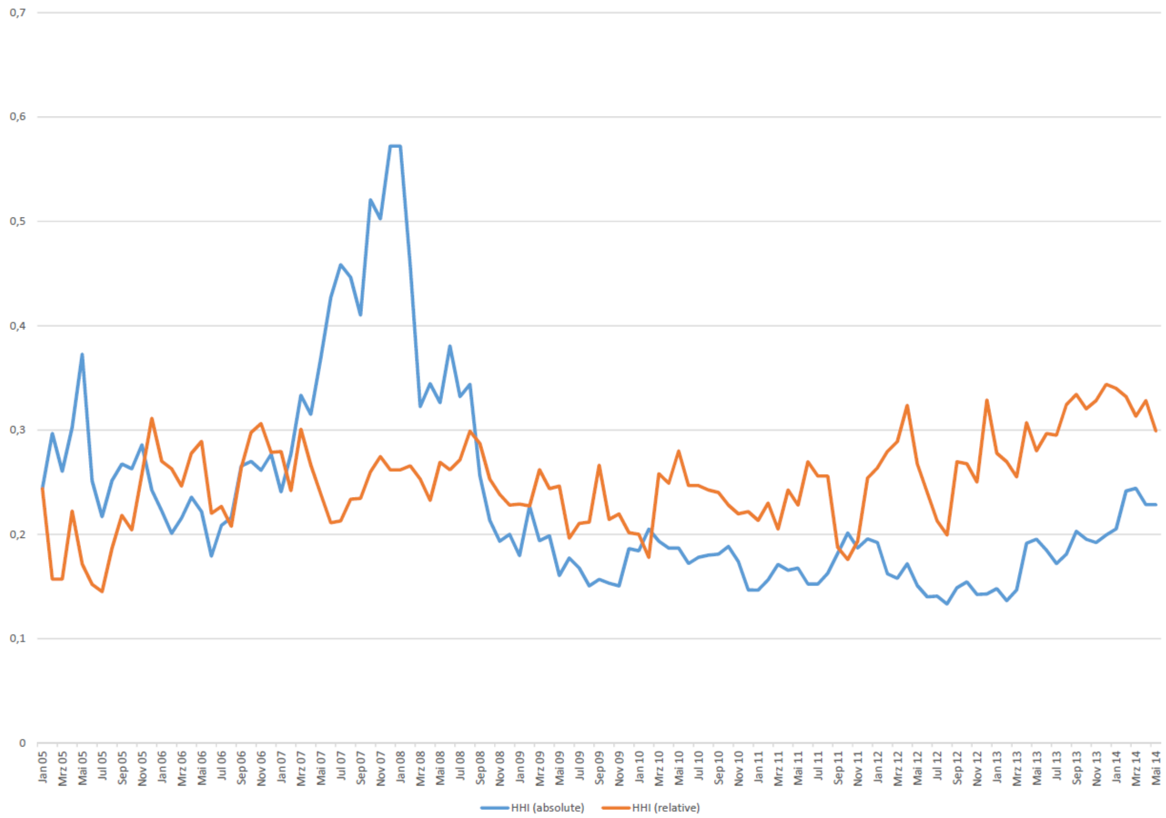


This figure shows the portfolio allocations by country for the global value portfolios over the January 2005 to May 2014 period. The first graph shows the allocations based on absolute NAV spreads (method 1); the second shows the allocations based on relative NAV spreads (method 2).

However, the average NAV spreads for U.K. stocks from the three mid quintiles are also lower than those of most value portfolios from other countries. Thus, large parts of the global value portfolio based on absolute NAV spreads consist of U.K. stocks, which are not cheap relative to other U.K. stocks. This contradicts the classical idea behind value investing. In contrast, during the same time period, the global value portfolio based on relative NAV spreads is dominated by stocks from Japan and Hong Kong – countries with a particularly strong dispersion of NAV spreads.

We use the Herfindahl-Hirschman Index (HHI) to measure the degree of portfolio concentration by country for both global value portfolios. The HHI is defined as the sum of the squared portfolio shares in a given period, and can range from 0 to 1, with 1 representing perfect concentration. Figure 2.4 shows that the degree of portfolio concentration of both global value portfolios is generally comparable. However, the concentration of the global value portfolio based on absolute mispricing exhibits a strong spike between 2007 and 2008, reflecting the high exposure to U.K. stocks during that period.

Figure 2.4: Herfindahl index for the global value portfolios.



This figure shows the portfolio diversifications by country as measured by the Herfindahl-Hirschman Index (HHI) for the global value portfolios over the January 2005 to May 2014 period. The blue line graph shows the HHI for the portfolio based on absolute NAV spreads (method 1); the orange line graph shows the HHI for the portfolio based on relative NAV spreads (method 2).

Essentially, the relative mispricing strategy ensures that the global value portfolio does not become overly concentrated in one country. This is because at least 50% of each country's stocks obtain positive relative NAV spreads. In contrast, when all stocks of a country trade at NAV discounts, they could theoretically all become part of the global value portfolio based on absolute NAV spreads, leading to significant country risk.

2.3.4 Risk-adjusted returns

To evaluate the risk-adjusted performance of our monthly trading strategy, we follow the mutual fund literature and use the Carhart four-factor model to obtain risk-adjusted returns (Carhart, 1997). We regress the excess returns of portfolio i on the excess return of the benchmark portfolio, as well as the size (SMB), book-to-market (HML), and momentum (WML) factors:

$$\begin{aligned}\text{Excess return}_{i,t} &= \alpha_i + \beta_{1,i}\text{benchmark excess return}_t \\ &+\beta_{2,i}\text{SMB}_t + \beta_{3,i}\text{HML}_t + \beta_{4,i}\text{WML}_t \qquad \text{(Eq. 2.3)}\end{aligned}$$

The excess return of portfolio i is calculated as the equally weighted return of all portfolio constituents in excess of their respective local currency's one-month risk-free rate.[10] We define the benchmark portfolio as the equally weighted portfolio of all stocks in our sample. Alternatively, we could use a broad stock market index that covers all sectors. However, this could result in all positive or all negative alphas for the three portfolios if the entire real estate sector over- or underperforms relative to the broad market.[11] We are interested only in the relative performance of the value portfolio within this particular sector, so we believe an equally weighted sector benchmark is most appropriate. It ensures that the average alpha of the three portfolios is 0. The excess return of the benchmark portfolio is also calculated as the equally weighted excess return of all stocks in our sample relative to their local currency risk-free rates.

In contrast to the benchmark portfolio, we do not restrict SMB, HML, and WML to the subsector of real estate stocks. This is done to reflect the original idea of the Carhart four-factor model, according to which SMB, HML, and WML are marketwide, and not industry-specific proxies for undiversifiable factor risk. In our international context, it may seem

[10] The risk free rate is the local currency one-month deposit rate for each country, as reported by Datastream.
[11] As a robustness check, we use the common broad market factor as opposed to the real estate-specific benchmark factor. As Table 2.5 in the Appendix shows, the alphas remain statistically significant.

straightforward to use global SMB, HML and WML factors. However, Griffin (2002) finds that domestic factor models explain time series portfolio variations much better than a world factor model. Thus, our SMB, HML, and WML factors are constructed according to the (time-varying) country weights of the benchmark portfolio.

The monthly SMB, HML, and WML factors are obtained from Kenneth French's website.[12] French's data library provides regional factors in USD for "Asia Pacific ex Japan," "Europe," "Japan," and "North America," so we convert the regional USD returns into local currency returns for the respective countries.

2.3.5 Summary statistics

Table 2.1 contains the descriptive statistics of total returns and NAV spreads for individual countries and for the global sample over the 2005:01 to 2014:05 period. Panel A shows the data at the individual stock level; panel B shows the same metrics at the aggregate index level, which are also used as benchmark portfolios. Panel A also reports the number of stocks per country and the total number of country-month observations; panel B reports the number of monthly portfolio observations for the indices.

The first column of panel A in Table 2.1 shows that the average monthly return of all real estate stocks over our sample period is 0.86%. Average returns are the highest in Sweden (1.56%) and the lowest in Germany (0.03%). Panel B shows similar returns when aggregated at the index level, but, of course, return volatility is substantially reduced, especially for the global index and for countries with a large number of stocks. For example, the monthly return volatility of the global sample of stocks is 10.62%, but it is only 5.51% at the diversified index level.

Columns 3 and 4 of Table 2.1 show the mean and standard deviation of the NAV spreads. On average, the entire sample of real estate stocks trades at a 32.53% premium to NAV over the sample period. The average premium is highest in Canada with 94.45%, and lowest in the Netherlands, with an average discount to NAV of -3.83%. The standard deviations of the NAV spreads are in panel A. They reveal a substantial degree of cross-sectional variation in the relative pricing of stocks within countries. The index-level NAV spreads are in panel B, and indicate that there is also substantial variation in the aggregate pricing levels over time

[12] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/datalibrary.html.

and across countries. This suggests that the relative mispricing strategy that accounts for these country effects may be well suited to exploit cross-country potential mispricings.

Table 2.2 contains the correlation coefficients for the time series of returns and NAV spreads at the aggregate index level. The correlation of country-level return indices (or benchmark portfolios) is shown in Panel A. Panel B shows the same metrics for the subsector of value stocks for the respective countries. Interestingly, the correlations for the value portfolios tend to be lower than those for the benchmark portfolios. The average correlation across countries (i.e., excluding the correlation with the global portfolio) is 54% for the benchmark portfolios and 47% for the value portfolios. This suggests that the benefits of international diversification across the value stock subsector are higher than those that can be obtained from general cross-country diversification. Panel C of Table 2.2 shows the correlations of the time series of average country-level NAV spreads. Although the average correlation coefficient is rather high at 60%, it is still far from perfect. Thus, international diversification benefits may also accrue from relative pricing levels across countries moving in different directions over time.

Table 2.2: Correlations of country-level returns and NAV spreads.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: Correlations of Country-Level Indices												
(1) Australia	1.00	-	-	-	-	-	-	-	-	-	-	-
(2) Belgium	0.47	1.00	-	-	-	-	-	-	-	-	-	-
(3) Canada	0.70	0.55	1.00	-	-	-	-	-	-	-	-	-
(4) France	0.61	0.77	0.71	1.00	-	-	-	-	-	-	-	-
(5) Germany	0.33	0.39	0.60	0.60	1.00	-	-	-	-	-	-	-
(6) Hong Kong	0.45	0.19	0.49	0.48	0.45	1.00	-	-	-	-	-	-
(7) Japan	0.52	0.34	0.50	0.41	0.39	0.47	1.00	-	-	-	-	-
(8) Netherlands	0.45	0.69	0.65	0.84	0.75	0.44	0.45	1.00	-	-	-	-
(9) Singapore	0.50	0.36	0.68	0.64	0.52	0.79	0.53	0.57	1.00	-	-	-
(10) Sweden	0.26	0.52	0.50	0.68	0.65	0.34	0.26	0.74	0.41	1.00	-	-
(11) United Kingdom	0.61	0.61	0.65	0.81	0.57	0.38	0.39	0.70	0.50	0.62	1.00	-
(12) Global	0.73	0.60	0.82	0.84	0.71	0.74	0.70	0.79	0.81	0.63	0.81	1.00
Panel B: Correlations of Value Portfolios												
(1) Australia	1.00	-	-	-	-	-	-	-	-	-	-	-
(2) Belgium	0.44	1.00	-	-	-	-	-	-	-	-	-	-
(3) Canada	0.53	0.37	1.00	-	-	-	-	-	-	-	-	-
(4) France	0.51	0.52	0.59	1.00	-	-	-	-	-	-	-	-
(5) Germany	0.36	0.34	0.51	0.54	1.00	-	-	-	-	-	-	-
(6) Hong Kong	0.47	0.13	0.54	0.51	0.41	1.00	-	-	-	-	-	-
(7) Japan	0.58	0.27	0.53	0.48	0.38	0.52	1.00	-	-	-	-	-
(8) Netherlands	0.43	0.41	0.58	0.68	0.67	0.44	0.49	1.00	-	-	-	-
(9) Singapore	0.49	0.33	0.60	0.56	0.37	0.70	0.51	0.47	1.00	-	-	-
(10) Sweden	0.32	0.35	0.52	0.64	0.58	0.45	0.35	0.60	0.46	1.00	-	-
(11) United Kingdom	0.50	0.43	0.54	0.67	0.40	0.29	0.35	0.43	0.32	0.49	1.00	-
(12) Global	0.68	0.46	0.70	0.80	0.68	0.69	0.66	0.70	0.65	0.63	0.79	1.00
Panel C: Correlations of NAV Spreads												
(1) Australia	1.00	-	-	-	-	-	-	-	-	-	-	-
(2) Belgium	0.81	1.00	-	-	-	-	-	-	-	-	-	-
(3) Canada	0.39	0.34	1.00	-	-	-	-	-	-	-	-	-
(4) France	0.79	0.84	0.35	1.00	-	-	-	-	-	-	-	-
(5) Germany	0.73	0.76	0.36	0.76	1.00	-	-	-	-	-	-	-
(6) Hong Kong	0.44	0.25	0.64	0.32	0.37	1.00	-	-	-	-	-	-
(7) Japan	0.82	0.78	0.41	0.72	0.82	0.47	1.00	-	-	-	-	-
(8) Netherlands	0.84	0.78	0.39	0.88	0.79	0.38	0.81	1.00	-	-	-	-
(9) Singapore	0.83	0.81	0.57	0.78	0.81	0.69	0.85	0.80	1.00	-	-	-
(10) Sweden	0.72	0.68	0.20	0.77	0.66	0.13	0.58	0.86	0.59	1.00	-	-
(11) United Kingdom	0.55	0.68	0.13	0.70	0.51	0.07	0.39	0.66	0.56	0.67	1.00	-
(12) Global	0.89	0.85	0.58	0.84	0.85	0.63	0.90	0.88	0.97	0.68	0.61	1.00

This table contains the correlation coefficients of monthly data over the January 2005 to May 2014 period. All returns are monthly and in local currencies. Panel A shows the correlation of total returns for equally weighted country-level indices; panel B shows the correlation of total returns for the value portfolios. The value portfolios consist of the quintile of stocks with the highest NAV discounts in a given month in the respective country. Panel C shows the correlation coefficients of the average NAV spreads in a given country. We calculate NAV spreads as the average equally weighted spread of all stocks in a given month for the respective country.

2.4 Empirical results

2.4.1 Raw returns

Table 2.3 shows the performance and portfolio characteristics of value (P1), middle (P2), growth (P3), and long-short (P1-P3) portfolios over the January 2005 to May 2014 period. While our primary objective is to examine the performance of globally diversified value portfolios, we also report results at an individual country level to provide a fuller sense of how country-level data tie to global data.

Table 2.3: Performance and characteristics of portfolios sorted by NAV spreads.

		Return Distribution (%)				
		Mean	Std. Dev	Min	Max	Sharpe Ratio
Panel A: Country Level						
Australia	P1	0.50	9.49	-62.25	29.80	0.01
	P2	0.10	6.59	-46.47	14.28	-0.05
	P3	0.16	5.62	-22.97	11.15	-0.04
	P1-P3	0.34	7.54	-39.28	29.25	0.05
Belgium	P1	1.09**	4.02	-15.93	10.40	0.23
	P2	0.61	4.08	-14.4	15.17	0.11
	P3	0.48	5.68	-27.50	15.10	0.06
	P1-P3	0.56**	5.00	-13.90	30.75	0.11
Canada	P1	1.33**	6.19	-29.70	21.57	0.19
	P2	1.07***	4.34	-22.06	10.89	0.21
	P3	0.96**	5.01	-17.07	14.53	0.16
	P1-P3	0.37	5.47	-17.07	15.87	0.07
France	P1	0.93	8.50	-30.45	26.80	0.09
	P2	1.02	7.13	-26.27	27.18	0.12
	P3	0.70	6.61	-18.95	18.90	0.08
	P1-P3	0.22	7.35	-25.70	23.50	-0.03
Germany	P1	0.80	14.76	-34.00	80.50	0.04
	P2	0.35	10.75	-38.52	54.40	0.02
	P3	-0.82	7.43	-23.10	26.50	-0.13
	P1-P3	1.46	14.88	-33.60	54.00	0.11
Hong Kong	P1	1.54	10.76	-28.40	53.04	0.13
	P2	1.38	10.17	-32.69	40.07	0.12
	P3	1.19	12.13	-35.93	40.00	0.09
	P1-P3	0.35	9.50	-32.68	25.87	0.04
Japan	P1	1.64*	9.72	-40.85	33.48	0.17
	P2	0.86	7.09	-16.73	25.68	0.12
	P3	0.76	9.26	-22.45	25.73	0.08
	P1-P3	0.88	7.46	-22.95	40.03	0.12
Netherlands	P1	0.75	12.32	-46.55	74.65	0.05
	P2	0.77	5.51	-13.30	17.65	0.11
	P3	-0.51	5.93	-21.70	10.50	-0.11
	P1-P3	1.19	11.29	-26.7	73.15	0.11

(continued on next page)

Table 2.3 *(continued)*

Singapore	P1	2.09**	8.98	-30.40	33.30	0.22
	P2	1.37*	8.46	-25.32	53.37	0.15
	P3	-0.54	7.41	-26.95	18.50	-0.09
	P1-P3	2.55***	6.81	-15.60	27.90	0.38
Sweden	P1	2.02**	8.97	-19.40	38.40	0.21
	P2	1.61**	7.72	-19.70	37.80	0.19
	P3	0.86	6.77	-15.00	20.40	0.10
	P1-P3	1.04	6.35	-11.90	19.30	0.17
United Kingdom	P1	1.61	12.84	-45.30	81.29	0.11
	P2	0.50	6.24	-22.40	31.33	0.05
	P3	0.40	6.09	-26.97	27.48	0.03
	P1-P3	1.21	9.48	-20.70	69.45	0.13
Panel B: Global Level						
1) Absolute NAV Spread	P1	1.46*	8.61	-37.26	40.49	0.15
	P2	0.82*	5.03	-26.35	13.76	0.13
	P3	0.63	5.33	-20.24	15.43	0.09
	P1-P3	0.83	6.33	-17.03	32.23	0.12
2) Relative NAV Spread	P1	1.58**	6.96	-30.12	29.33	0.21
	P2	0.78	5.52	-28.17	16.70	0.11
	P3	0.60	5.22	-21.94	14.40	0.09
	P1-P3	0.98***	3.83	-8.17	15.95	0.26

This table contains the performance and portfolio characteristics of real estate stock portfolios sorted according to their NAV spreads over the January 2005 to May 2014 period (n = 117). All returns are monthly and in local currencies. Panel A shows the results at the individual country level. The P1 portfolio consists of the quintile of stocks with the highest NAV discounts in a given month; the P2 portfolio consists of stocks in the middle three quintiles of stocks sorted according to their NAVs; the P3 portfolio consists of stocks with the highest NAV premiums in a given month; and P1-P3 represents the long-short portfolio. Panel B shows the results at the global level. Methods (1) and (2) differ regarding the sorting procedure that is used to construct the portfolios. Method (1) sorts the global sample of stocks according to their absolute NAV spreads in a given month; method (2) sorts the global sample according to each stock's NAV spread relative to the average NAV spread in the respective country in a given month. Parameters marked ***,**, and * are significant at the 1%, 5%, and 10% levels, respectively.

Columns 1–5 of Table 2.3 show the mean, standard deviation, minimum, and maximum of the portfolio returns, as well as the Sharpe ratio. Panel A reports results at an individual country level, and panel B reports results at the global level, where the portfolios are sorted according to either the absolute or relative NAV spread as described in section 2.3.2.

The country-level results in panel A reveal a consistent pattern regarding the relative performance of the value portfolios. For example, the value portfolio (P1) outperforms the growth portfolio (P3) in each country. Moreover, except for France and the Netherlands, the value portfolio also outperforms the middle portfolio (P2) in most cases. At the same time, the value portfolios appear more risky, as indicated by the fact that the highest volatility for the three portfolios is found in nine of the eleven cases. This outperformance of the value portfolio is most pronounced in Germany, Japan, Singapore, and the U.K., where the average excess return of the long-short portfolio (P1-P3) is greater than 0.5% per month.

Overall, the country-level results are in line with the literature. And they lead us to the question whether the risk associated with the strong relative performance of the value portfolios at the individual country level can be diversified at the global level. However, we caution against overinterpreting the country-level results, because the number of portfolio constituents is very low in many cases. In contrast, the number of stocks in the value portfolio at the global level ranges from 21 to 38, which is sufficiently high from which to draw empirical conclusions.

Panel B shows the return distribution of the global portfolios that are constructed according to either absolute or relative NAV spreads. In general, the global-level results are consistent with the findings for individual countries. According to both sorting procedures, the value portfolio provides the highest returns, but it is also the most risky as measured by monthly return volatility. Overall, the results in Table 2.3 are in line with Hypothesis 2.1, which is tested in the following section where we examine risk-adjusted returns.

Interestingly, the value portfolio that is sorted according to relative mispricing has both higher average returns (1.58% versus 1.46%) and lower risk (6.96% versus 8.61%) than the value portfolio sorted according to absolute NAV spreads. This result is in line with Hypothesis 2.3. On an annualized basis, the global value portfolio based on relative mispricing outperforms its global growth equivalent by 12.4%. The annualized value premium, defined as the return of the value portfolio over the benchmark portfolio, is 10.4%.

Figure 2.5 illustrates the empirical evidence by plotting the cumulative log returns to the value, middle, and growth portfolios over the sample period. The results are consistent with Table 2.3: The cumulative returns to the value portfolio are highest in eight of the eleven countries. The outperformance of the two global value strategies is evident in the last two subfigures, where the graph for the relative mispricing strategy shows the most pronounced outperformance.

Figure 2.5: Cumulative (log-) returns of portfolios sorted by NAV spreads.

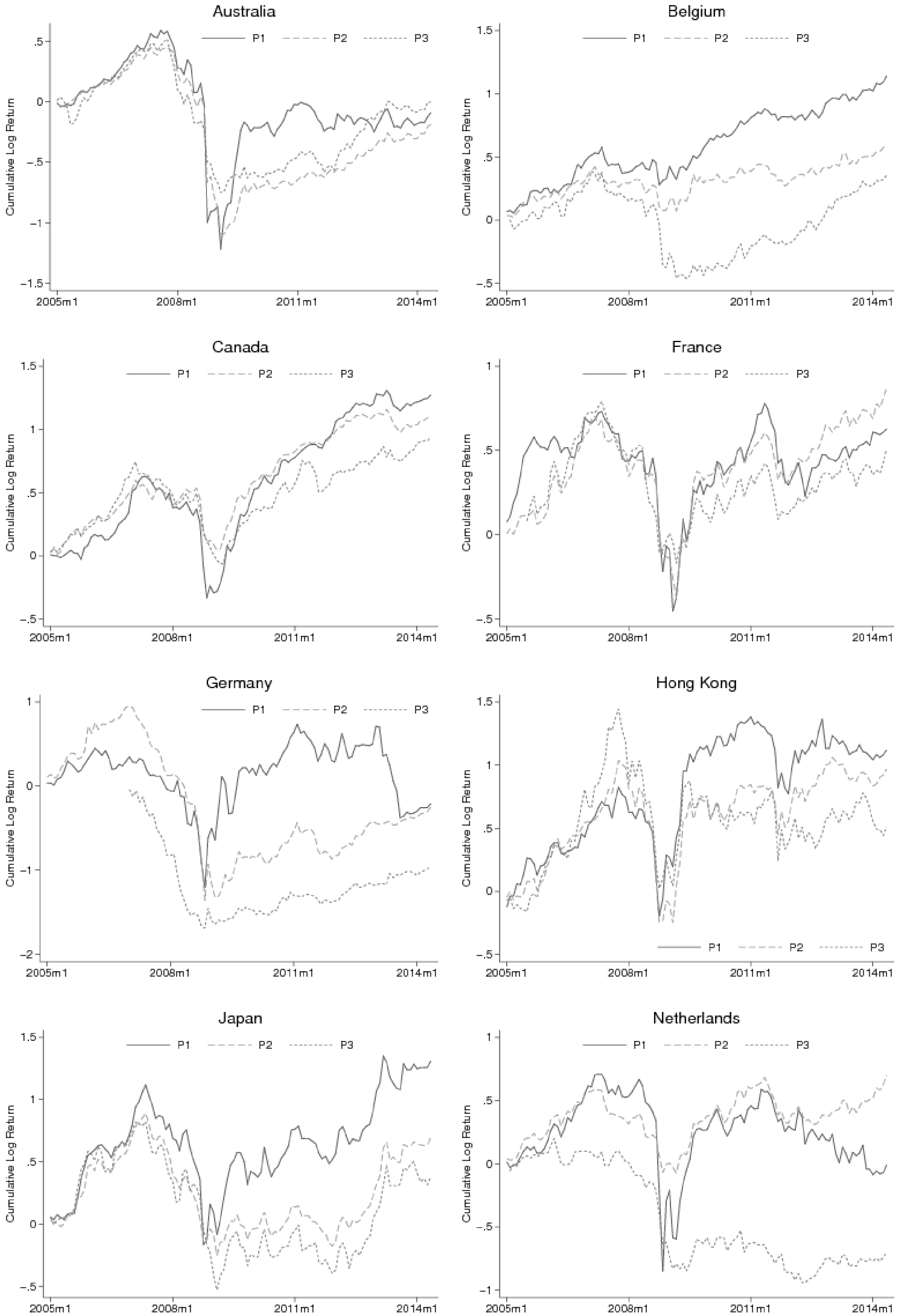


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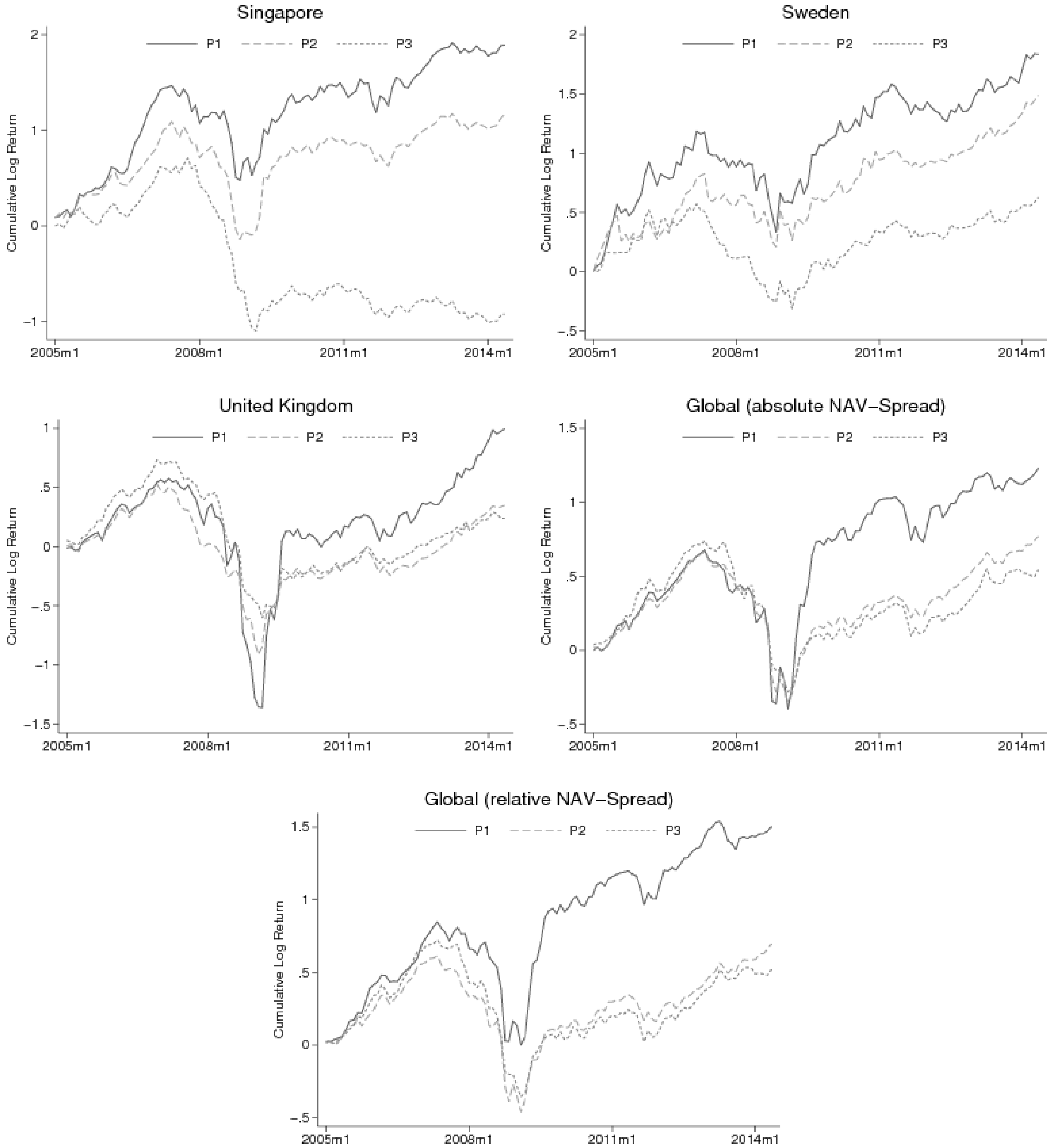
Figure 2.5 ***(continued)***



This figure (figure 2.5) shows the cumulative (log) returns of portfolios of real estate stocks sorted according to their NAV discounts for eleven countries, as well as two global portfolios over the January 2005 to May 2014 period. All (log) returns are monthly and in local currencies. The P1 portfolio consists of the quintile of stocks with the highest NAV discounts in a given month; the P2 portfolio consists of stocks in the middle three quintiles of stocks sorted according to their NAVs; and the P3 portfolio consists of stocks with the highest NAV premiums in a given month. Two different sorting procedures are used in portfolio construction: (1) sorting on absolute NAV spreads in a given month, and (2) sorting on relative NAV spreads in a respective country in a given month.

Over the entire sample period, the relative mispricing strategy produces cumulative log returns of 150.4%. This results in a cumulative outperformance of 27.6%, compared to the absolute mispricing strategy with cumulative log returns of 122.8%. Figure 2.5 reveals that most of the outperformance occurs in the first half of the sample period. Until the first peak in May 2007, the relative strategy outperforms the absolute strategy by 16.7%. In the subsequent subperiod until the financial crisis peak in February 2009, the outperformance increases to 39.61%.

Figure 2.2 suggests that the outperformance is attributable to the country allocations. The global value portfolio based on absolute mispricing is dominated by U.K. stocks, with cumulative log returns of 135.3% until February 2009. Over the same period, the global value portfolio based on relative mispricing is dominated by value stocks from Japan and Hong Kong, with much higher cumulative log returns of 8.2% and 26.6%. This subperiod analysis suggests that the relative mispricing strategy does particularly well in falling markets.

2.4.2 Risk-adjusted returns

Table 2.4 contains the regression results for the Carhart four-factor model regressions, which are based on the same portfolios as in Table 2.3. To test Hypotheses 2.1–2.3, our focus is on the intercepts of the regressions that can be interpreted as alphas or risk-adjusted returns, where the t-statistics indicate their statistical significance.

Table 2.4: Risk-adjusted performance of portfolios sorted by NAV spreads (Carhart four-factor model).

		Alpha		MKT		SMB		HML		WML		R^2
Panel A: Country Level												
Australia	P1	0.379	(1.04)	1.277***	(20.58)	0.075	(0.68)	-0.008	(-0.07)	-0.260***	(-2.85)	84.1
	P2	-0.204	(-1.30)	1.026***	(38.70)	0.008	(0.16)	0.030	(0.64)	0.057	(1.46)	94.0
	P3	-0.120	(-0.35)	0.653***	(11.13)	-0.087	(-0.84)	-0.131	(-1.26)	0.138	(1.60)	59.8
	P1-P3	0.499	(0.87)	0.624***	(6.39)	0.162	(0.94)	0.123	(0.71)	-0.398***	(-2.77)	37.6
Belgium	P1	0.427*	(1.80)	0.869***	(13.40)	-0.025	(-0.29)	-0.004	(-0.04)	0.003	(0.05)	66.2
	P2	-0.111	(-0.76)	1.006***	(25.29)	-0.005	(-0.10)	0.042	(0.65)	-0.037	(-1.02)	87.7
	P3	-0.407	(-1.15)	1.242***	(12.84)	0.046	(0.36)	-0.096	(-0.61)	0.102	(1.15)	62.8
	P1-P3	0.807	(1.65)	-0.381***	(-2.85)	-0.082	(-0.46)	0.084	(0.39)	-0.097	(-0.79)	7.6
Canada	P1	0.233	(0.82)	1.083***	(15.23)	0.133	(1.14)	-0.214*	(-1.92)	-0.157**	(-2.34)	78.8
	P2	0.008	(0.07)	0.950***	(33.32)	-0.070	(-1.49)	0.028	(0.62)	0.029	(1.09)	93.1
	P3	-0.108	(-0.34)	0.966***	(12.33)	0.069	(0.53)	0.130	(1.05)	0.131*	(1.77)	60.8
	P1-P3	0.341	(0.70)	0.117	(0.96)	0.064	(0.32)	-0.344*	(-1.81)	-0.288**	(-2.52)	21.2
France	P1	0.161	(0.35)	0.929***	(11.36)	-0.109	(-0.62)	0.292	(1.38)	-0.298**	(-2.46)	71.2
	P2	0.020	(0.12)	1.059***	(35.40)	0.068	(1.06)	-0.059	(-0.77)	-0.010	(-0.22)	94.6
	P3	-0.324	(-0.88)	0.890***	(13.80)	-0.179	(-1.27)	-0.035	(-0.21)	-0.371***	(3.85)	71.4
	P1-P3	0.262	(0.39)	0.011	(0.09)	0.088	(0.34)	0.219	(0.70)	-0.712***	(-3.97)	20.1
Germany	P1	0.509	(0.64)	1.124***	(12.55)	-0.163	(-0.54)	0.670*	(1.94)	-0.436**	(-2.12)	70.9
	P2	-0.047	(-0.14)	1.041***	(27.21)	0.192	(1.49)	-0.330*	(-2.23)	0.050	(0.57)	90.0
	P3	-1.022	(-1.63)	0.470***	(6.90)	-0.259	(-1.16)	0.062	(0.23)	0.303**	(2.00)	45.1
	P1-P3	2.151***	(1.69)	0.730*	(5.27)	0.103	(0.23)	0.676	(1.26)	-0.691**	(-2.24)	42.7
Hong Kong	P1	0.145	(0.29)	0.918***	(19.19)	0.196	(1.30)	0.281	(1.34)	-0.331***	(-2.70)	81.0
	P2	0.116	(0.60)	0.993***	(53.79)	-0.098*	(-1.69)	-0.107	(-1.32)	-0.027	(-0.58)	96.8
	P3	-0.476	(-0.79)	1.102***	(19.13)	0.003	(0.02)	-0.180	(-0.71)	0.427***	(2.90)	78.3
	P1-P3	0.620	(0.65)	-0.183**	(-2.00)	0.193	(0.67)	0.461	(1.15)	-0.758***	(-3.24)	11.1
Japan	P1	0.522	(1.39)	1.147***	(22.20)	0.269**	(2.52)	0.031	(0.23)	-0.313***	(-3.50)	84.5
	P2	-0.077	(-0.50)	0.929***	(44.25)	-0.114**	(-2.62)	-0.074	(-1.36)	0.102***	(2.80)	95.2
	P3	-0.502	(-1.14)	1.046***	(17.29)	-0.002	(-0.01)	0.232	(1.47)	0.003	(0.03)	76.6
	P1-P3	1.024	(1.45)	0.100*	(1.82)	0.271**	(2.38)	-0.201	(-1.40)	-0.317***	(-3.31)	7.8

(continued on next page)

Figure 2.4 ***(continued)***

Netherlands	P1	0.097	(0.18)	1.702***	(16.81)	0.330	(1.52)	-0.517**	(-2.07)	-0.145	(-1.02)	80.3
	P2	0.204	(0.86)	0.752***	(17.20)	-0.083	(-0.89)	0.199*	(1.84)	0.021	(0.35)	81.8
	P3	-1.242***	(-2.77)	0.566***	(6.94)	-0.396**	(-2.31)	0.287	(1.45)	0.168	(1.48)	50.7
	P1-P3	1.196	(1.35)	1.195***	(7.43)	0.695**	(2.06)	-0.877**	(-2.25)	-0.263	(-1.18)	46.8
Singapore	P1	0.710*	(1.89)	1.050***	(19.50)	-0.284**	(-2.64)	0.066	(0.52)	0.077	(0.80)	82.6
	P2	0.042	(0.24)	1.035***	(40.58)	0.119**	(2.33)	-0.005	(-0.09)	-0.069	(-1.51)	95.6
	P3	-1.373***	(-2.85)	0.722***	(10.39)	-0.217	(-1.58)	-0.224	(-1.36)	0.241*	(1.95)	58.3
	P1-P3	2.093***	(3.33)	0.329***	(3.63)	-0.064	(-0.36)	0.288	(1.35)	-0.161	(-1.00)	16.6
Sweden	P1	0.332	(0.84)	1.053***	(18.01)	-0.151	(-0.98)	0.161	(0.91)	-0.031	(-0.31)	80.9
	P2	0.001	(0.01)	1.028***	(41.07)	0.022	(0.34)	-0.061	(-0.81)	0.024	(0.57)	95.3
	P3	-0.464	(-1.21)	0.818***	(13.84)	0.121	(0.82)	0.109	(0.61)	-0.023	(-0.24)	72.6
	P1-P3	0.596	(0.96)	0.276***	(2.88)	-0.240	(-1.01)	-0.064	(-0.22)	-0.046	(-0.30)	17.8
United	P1	1.114***	(3.01)	1.572***	(23.09)	0.573***	(3.83)	-0.012	(-0.07)	-0.593***	(-5.54)	92.0
Kingdom	P2	-0.361**	(-2.51)	0.850***	(32.05)	-0.176***	(-3.02)	0.036	(0.59)	-0.108**	(2.59)	94.9
	P3	-0.686**	(-2.13)	0.858***	(14.50)	-0.028	(-0.22)	-0.163	(-1.19)	0.433***	(4.66)	73.3
	P1-P3	1.780***	(3.39)	0.714***	(7.31)	0.601***	(2.80)	0.151	(0.67)	-1.025***	(-6.68)	69.8
Panel B: Global Level												
1)Absolute	P1	0.578**	(2.25)	1.237***	(21.18)	0.063	(0.55)	0.401***	(3.35)	-0.625***	(-8.28)	91.4
NAV Spread	P2	-0.098	(-1.36)	0.930***	(56.93)	-0.032	(-1.01)	-0.052	(-1.57)	0.089***	(4.24)	98.1
	P3	-0.373	(-1.58)	0.962***	(18.00)	0.006	(0.06)	-0.299***	(-2.74)	0.356***	(5.17)	81.3
	P1-P3	0.969**	(2.13)	0.287***	(2.79)	0.075	(0.63)	0.626***	(3.55)	-0.965***	(-7.15)	53.1
2)Relative	P1	0.767***	(3.26)	1.109***	(20.76)	0.297***	(2.85)	-0.135	(-1.24)	-0.243***	(-3.53)	89.1
NAV Spread	P2	-0.175*	(-1.70)	0.982***	(42.03)	-0.072	(-1.58)	0.085*	(1.77)	-0.002	(-0.08)	96.7
	P3	-0.371*	(-1.96)	0.938***	(21.86)	-0.095	(-1.13)	-0.157*	(-1.79)	0.245***	(4.42)	87.4
	P1-P3	1.060***	(3.51)	0.167***	(2.72)	0.387***	(3.11)	-0.024	(-0.17)	-0.470***	(-5.83)	40.81

This table contains the risk-adjusted returns of real estate stock portfolios sorted according to their NAV discounts over the January 2005 to May 2014 period (n = 117). We obtain risk-adjusted returns (alphas) from time series regressions of the excess portfolio returns (P1, P2, P3, and P1-P3) on the excess benchmark portfolio (MKT) return, the global SMB risk factor, the global HML risk factor and the global WML risk factor. All returns are monthly and in local currencies. The risk-free rate is the local currency one-month T-bill rate. In panel A, the market return is the equally weighted return of all real estate stocks of the respective country; in panel B, the market return is the equally weighted return of all global stocks. Panel A shows the risk-adjusted returns at the individual country level. The P1 portfolio consists of the quintile of stocks with the highest NAV discounts in a given month; the P2 portfolio consists of stocks in the middle three quintiles of stocks sorted according to their NAVs; the P3 portfolio consists of stocks with the highest NAV premiums in a given month; and P1-P3 represents the long-short portfolio. Panel B shows the risk-adjusted returns at the global level. Methods (1) and (2) differ regarding the sorting procedure that is used to construct the portfolios. Method (1) sorts the global sample of stocks according to their absolute NAV spreads in a given month; method (2) sorts the global sample according to each stock's NAV spread relative to the average NAV spread in the respective country in a given month. T-statistics are in parentheses, and parameters marked ***,**, and * are significant at the 1%, 5%, and 10% levels, respectively.

Panel A of Table 2.4 contains the country-level results for the Carhart four-factor model regressions (Eq. (2.3)). In general, alphas tend to be highest for the value portfolios (P1), and lowest for the growth portfolios (P3). However, only the alphas for the value portfolios of Belgium, Singapore, and the UK are significantly different from 0. The alphas for the long-short portfolio (P1-P3) are statistically significant for Germany, Singapore, and the UK.

The coefficients on the benchmark portfolios, or "betas," can be interpreted as measures of the respective portfolios' exposures to systematic risk. The betas of the value portfolios tend to be the highest, and the betas of the growth portfolios tend to be the lowest. This indicates that the growth portfolios carry lower systematic risk. As in Table 2.2, Belgium and Hong Kong are the exceptions, with riskier growth than value portfolios. The R-squareds are generally relatively high, which is due to the narrow definition of the benchmark portfolio. This is particularly true for the middle portfolio (P2), where the overlap with the benchmark portfolio is 60% (three out of five quintiles). Again, the country-level results should be interpreted with caution because of the low number of portfolio constituents in many cases. The resulting vulnerability to outliers may explain the lack of statistical significance of most of the alphas, although the economic differences between them are generally substantial. Overall, and in conjunction with the country-level raw returns of Table 2.3, the results are in line with Hypothesis 2.1: At the individual country level, value portfolios tend to produce higher returns in absolute terms, but not on a risk-adjusted basis.

However, our primary focus is on the global-level results, which are shown in panel B of Table 2.4. The alphas of both global value portfolios are positive and statistically significant. Furthermore, using both methods, the long-short strategy (P1-P3) produces even higher statistically significant risk-adjusted returns. These results are consistent with Hypothesis 2.2 and suggest that the country-specific component of the factor risk of value stocks can be diversified at a global level. Comparing the alpha coefficients for methods 1 and 2 reveals that the relative mispricing strategy (method 2) produces better risk-adjusted returns than the absolute mispricing strategy (0.77% per month vs. 0.58% per month). This result supports Hypothesis 2.3: The relative mispricing strategy is better suited to capture the global value premium.

Comparing the beta coefficients provides a potential explanation for the differences in the risk-adjusted performance of both global portfolios. The beta of the method 1 strategy is

1.24, while the beta of method 2 is only 1.11, which suggests the latter value portfolio is less exposed to systematic risk.

The analysis of the portfolio sensitivities with respect to the other systematic risk factors SMB, HML, and WML reveals further important insights. Although we may expect that the value portfolios will load heavily on the book-to-market factor (HML), this is actually only true in Germany and for the global value portfolio sorted according to absolute NAV spreads. Interestingly, the global value portfolio sorted by relative NAV spreads is not sensitive to the book-to-market factor. This suggests that sorting the global value portfolio according to relative mispricing reduces its risk exposure with respect to the global book-to-market factor. However, the global value portfolio of method 2 is sensitive with respect to the SMB factor, although this is not true for method 1. Nevertheless, even after controlling for the small stock risk factor, the risk-adjusted performance of method 2 remains highly significant.

Consistent with the anti-cyclical nature of value investing strategies, both global value portfolios load negatively on the WML factor. The portfolio sorted according to absolute mispricing is even less exposed to the momentum risk factor than that sorted according to relative mispricing.[13] In summary, NAV spreads are a good indicator of future performance.[14]

The country-level results show that value stocks have higher returns, but are also more risky. The relatively high risk of value stocks at a country level can be reduced significantly by a global diversification strategy. Based on the common four-factor Carhart model, both global value investment strategies provide superior risk-adjusted returns. However, both the single-factor model results, and a comparison of the economic and statistical significance of the

[13] To test whether the risk exposures of the global value portfolios change over time, we examine thirty-six-month rolling windows for the time variation in the risk loadings. In untabulated results, we find that the risk loadings on MKT are relatively constant for both strategies, while those on SMB, HML, and WML tend to vary somewhat over the sample period. However, a comparison of the R-squareds in Table 2.4 suggests that SMB, HML, and WML do not contribute much explanatory power to our model. Hence, time variation in the risk loadings does not appear to be critical to our major empirical findings.

[14] Potentially, other measures of price-to-fundamental value may lead to the same relative sort, even if the absolute sort is different. As suggested by an anonymous referee, we use alternative measures of price-to-fundamental value to test this theory. The results of additional robustness checks show substantial differences when we use the price-to-earnings ratio or the ratio of price to funds from operations (FFO) as alternative ranking criteria. Only in the case of the global value portfolio sorted according to the P/E ratio we find weak evidence of outperformance. These alternative results strengthen our arguments in favor of NAV spreads as reliable indicators of discrepancies between price and fundamental value. These results are available from the authors upon request.

alpha coefficients, suggest the strategy based on relative NAV spreads (method 2) continues to outperform the strategy based on absolute NAV spreads.[15]

2.4.3 Return dynamics

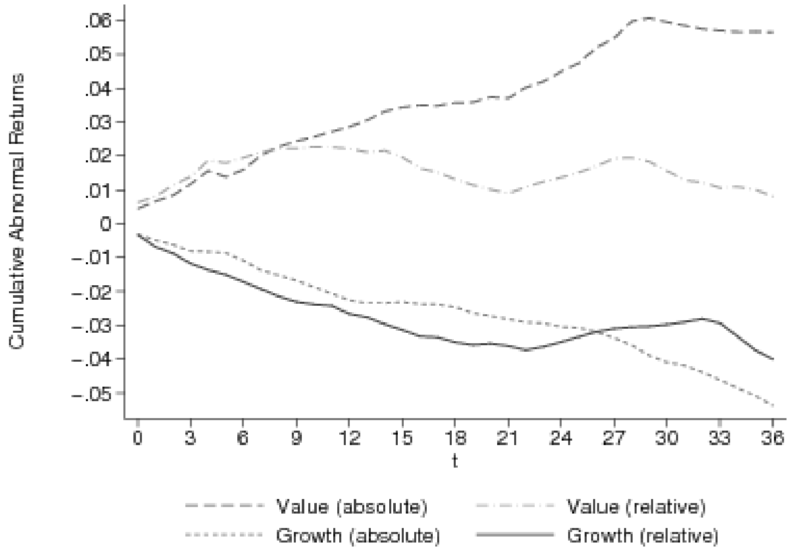
The outperformance of the relative mispricing strategy can be traced back to higher returns *and* less risk. The geographic allocations of both global value portfolios shown in Figure 2.3, however, suggest that the relative mispricing strategy is more effective at avoiding excessive risk exposure to individual countries. While international diversification certainly helps improve returns after adjusting for risk, it is less clear why the relative mispricing strategy would also produce higher absolute returns.

To answer this question, we believe the short-term nature of the monthly trading strategy needs to be considered. As shown in Figure 2.2, it is not uncommon for the value stocks of individual countries to trade at substantial discounts to NAV over extended periods. For this reason, a monthly investment horizon may not be the most efficient way to exploit absolute mispricings. Of course, relative mispricings may also persist for extended periods. However, as Figure 2.2 suggests, country-level dispersions between value and growth stocks can be extreme, but do not generally remain that way for long periods. In effect, both investment strategies invest in stocks with the strongest respective disequilibria in a given month. In the end, success depends on the strength and on the speed of reversion of the disequilibrium.

Figure 2.6 shows the cumulative abnormal returns (CARs) of the global value and growth portfolios for both strategies over the thirty-six months following portfolio formation. The gray dashed line shows the CARs for the global value portfolio based on relative mispricing; the black dashed line shows the performance based on absolute mispricing.

[15] At the request of an anonymous referee, we also test the robustness of our results by using a five-factor model, which includes the liquidity factors suggested in Pastor and Stambaugh (2003). We use both the traded and the untraded liquidity factors provided on Lubos Pastor's homepage. In both cases, the results are robust and consistent with the results in Table 2.4. These results are available from the authors upon request.

Figure 2.6: Long-run performance of value and growth stocks based on absolute and relative NAV spreads.



This figure shows the cumulative abnormal performance for value and growth stocks based on absolute and relative NAV spreads, for the thirty-six months following portfolio formation. The solid line shows the performance for growth stocks; the dashed line shows the performance for value stocks.

While the global value portfolio based on absolute mispricing produces higher returns over the complete thirty-six-month period (5.66% versus 0.81%), the relative mispricing wins over the short run. It exhibits higher returns (0.62% versus 0.45%) in the first month following portfolio formation, and leads the absolute strategy until the seventh month afterward. This suggests that relative mispricing disequilibria tend to be reversed more quickly and more intensively, while the absolute strategy produces better returns in the long run.

The results for the global growth portfolios are consistent. Initially, the CARs for the relative mispricing portfolio are more negative than those for the absolute mispricing portfolio. The return differential increases until the eighteenth month after portfolio formation. However, after thirty-six months, the CARs of the portfolio based on absolute mispricing are more negative than those based on relative mispricing (-5.38% versus -4.00%). Together, these results suggest that the short-term dynamics of the relative mispricing strategy are better suited for a monthly trading strategy, while the absolute mispricing strategy appears to work better over longer investment horizons.

2.4.4 Discussion

Our empirical results are consistent with the literature on the value premium, which suggests that absolute mispricing is important in terms of predicting future returns. However, we also find that relative mispricing is even better at predicting future returns. What is the theory that predicts investors care about relative mispricing?[16]

To the best of our knowledge, there is no extant literature on the concept of relative mispricing as introduced here. However, a related investment strategy known as "pairs trading" is widely applied by active investors such as hedge funds or investment banks. Gatev et al. (2006) describe pairs trading as a statistical arbitrage tool. The idea is to find two stocks whose prices have moved together historically. When the spread between them widens, the investor shorts the winner and buys the loser. Gatev et al. (2006) find that this trading rule on average yields up to 11% annualized excess returns.

Due to their homogeneity, real estate stocks from the same country are natural candidates for pairs with equilibrium relationships. Mori and Ziobrowski (2011) examine a pairs trading strategy for U.S. REITs, which we exclude here, and document superior profits for this strategy over common stocks for the 1993-2000 period. Accordingly, the relative mispricing strategy introduced in this paper can also be thought of as a global-level pairs trading strategy, which invests in pairs with the strongest price dispersions. The global investment spectrum increases the chances of finding pairs with substantial price dispersion. At the same time, cross-country diversification should reduce systematic country risk to some extent.

While both investment strategies are theoretically appealing, the question is whether real-world investors actually behave this way, in other words, whether they care about absolute or relative mispricing. Theoretically, any active investor trying to beat a passive benchmark index might consider trading signals based on absolute or relative mispricing.

Actively managed equity mutual funds with a focus on real estate stocks are an important group of investors. Worldwide, there are 1,173 of these funds, with total assets under management of $264.6 billion as of December 2016, according to Morningstar Direct. Among these, 251 invest globally, while 922 are focused on specific regions or countries.

[16] We thank an anonymous referee for drawing our attention to this issue.

The absolute mispricing strategy can be applied at either a global or an individual country level. Interestingly, there is some empirical evidence that real estate mutual funds are able to beat their benchmark, which is generally not the case for common equity mutual funds. For example, Gallo et al. (2000) find that the U.S. REIT mutual funds in their sample outperform their benchmark as a group by more than 5% per year on a risk-adjusted basis. Cici et al. (2011) also document significant positive alphas for U.S. REIT mutual funds. Consistent with a focus on absolute mispricing signals, the authors find evidence that part of the outperformance is related to NAV-to-price ratios.

In contrast, the relative mispricing strategy requires a global investment spectrum. To the best of our knowledge, we are not aware of any studies on the performance of REIT mutual funds at the global level.

There are also institutional reasons why the relative mispricing strategy yields better results than the absolute mispricing strategy. For example, it appears to better control for various types of systematic differences across countries, such as differences in accounting practices, which may justify systematically different levels of NAV discounts. While Horton et al. (2013) note that the introduction of IFRS and associated fair value-based accounting regimes in many countries has increased the information quality and accounting comparability across countries, Kvaal and Nobes (2010) reject the hypothesis that IFRS practices are the same across countries. Hence, the international comparability of accounting data remains inadequate.

A similar argument can be made for cross-country differences regarding tax regimes. Note that the REIT structure that is so prevalent in many companies in our sample is often associated with strong tax advantages. Consequently, a higher premium to NAV would be warranted for REIT-dominated countries, or for countries with low corporate taxes. This may explain the high average premium to NAV for Canadian stocks, which are all classified as REITs, and are hence not subject to taxation at the corporate level.

Hence, a fair value-based NAV is clearly an imperfect measure of fundamental value, although it is certainly better than historical cost-based book values of, e.g., tech companies. Therefore, large NAV discounts may simply be justified, or at least uncertainty regarding the justification may warrant a risk premium.

We acknowledge some potential limitations of our study. To avoid the impact of exchange rate effects on our results, for example, we consistently use local currency returns, which assume fully hedged positions. And accounting for hedging costs would reduce absolute performance, but our major implications regarding the relative performance of the global value portfolio over the global growth portfolio should be unaffected.

Furthermore, we do not account for transaction costs, which may be particularly high if portfolios are rebalanced on a monthly basis. Currency hedging costs should exhibit a symmetrical effect on all portfolios and on the benchmark. But transaction costs may be more detrimental to a global value portfolio if it invests predominantly in smaller, and hence potentially less liquid, stocks with higher transaction costs.

We attempt to minimize any issues caused by small and illiquid stocks by choosing an index with particularly strong minimum liquidity requirements. For this reason, Serrano and Hoesli (2009) find that the FTSE/EPRA Global Real Estate Index is well suited to evaluate the performance of active trading strategies.[17] Nevertheless, the global value portfolio sorted according to relative mispricing loads significantly on the SMB factor, which suggests relative transaction costs are higher. Assuming that transaction costs for stocks in the global value portfolio are 0.5% higher per trade, and assuming an annual turnover rate of 100% for all portfolios and the benchmark, the annualized value premium would be reduced by 1%.

2.5 Conclusion

This paper examines a global value investment strategy in the context of fair value-based NAVs as proxies for fundamental value. We consider a special case of global diversification by focusing on value stocks whose risk-return profiles make potential diversification gains particularly desirable. We use a sample of 255 real estate stocks in 11 countries with fair value-based accounting regimes over the 2005–2014 period. We find the value premium can be captured using a global investment strategy, but only when based on relative instead of absolute mispricing.

[17] As suggested by a referee, we run two additional robustness tests to ensure the minimum liquidity requirements of the FTSE/EPRA Global Real Estate Index are sufficient. First, we exclude the decile of stocks with the lowest market capitalization by country. Next, we exclude the decile of stocks with the highest bid-ask spreads. In both cases, our results remain robust and consistent with the Table 2.4 results. The results are available from the authors upon request.

Investing in the most attractively priced stocks relative to their peers in the same country seems a particularly suitable way to benefit from short-term return dynamics. Our results suggest that the country-level “catching-up” processes are driving our results. Because there are few theoretical reasons why this type of mean reversion at a country level would be highly correlated across countries, this opens the potential for strong diversification gains, which may ultimately explain the superior risk-adjusted returns. Overall, our results suggest that the value premium is diversifiable, at least at a global level. This finding is in contrast to Fama and French (1993), who argue that the excess returns of value stocks are subject to undiversifiable factor risk.

While our empirical results are based on a sample of real estate stocks, our findings have broader implications. In principle, we believe our empirical approach, which includes the methodological innovation of sorting stocks based on relative NAV spreads, could be transferred to any international or intersectoral dataset that provides relatively reliable estimates of fundamental value.

2.6 Appendix

Table 2.5: Risk-adjusted Performance of Portfolios Sorted by NAV Spreads (Carhart Four-Factor Model) with Overall Market Factor.

		Alpha		MKT		SMB		HML		WML		R^2
Panel A: Country Level												
Australia	P1	0.000	(0.07)	1.281***	(6.43)	-0.122	(-0.59)	-0.128	(-0.62)	-0.261	(-1.51)	43.6
	P2	-0.005	(-1.01)	1.082***	(7.75)	-0.147	(-1.02)	-0.059	(-0.40)	0.061	(0.50)	42.7
	P3	-0.004	(-0.91)	0.905***	(7.70)	-0.170	(-1.40)	-0.154	(-1.26)	0.159	(1.56)	44.3
	P1-P3	0.004	(1.10)	0.376***	(3.45)	0.048	(0.43)	0.026	(0.23)	-0.420***	(-4.44)	17.0
Belgium	P1	0.007**	(2.06)	0.432***	(4.36)	-0.027	(-0.19)	0.120	(0.72)	-0.002	(-0.02)	23.5
	P2	0.003	(0.81)	0.351***	(3.48)	-0.100	(-0.70)	0.295*	(1.73)	-0.077	(-0.82)	23.4
	P3	-0.000	(-0.03)	0.683***	(4.82)	0.081	(0.40)	0.026	(0.11)	0.112	(0.86)	22.2
	P1-P3	0.007**	(2.49)	-0.265***	(-3.36)	-0.127	(-1.13)	0.087	(0.65)	-0.113	(-1.55)	3.9
Canada	P1	0.010**	(2.36)	0.810***	(6.23)	0.134	(0.75)	-0.414**	(-2.46)	-0.464***	(-4.88)	51.0
	P2	0.007**	(2.23)	0.610***	(6.17)	-0.053	(-0.39)	-0.154	(-1.21)	-0.252***	(-3.48)	42.5
	P3	0.005	(1.35)	0.807***	(6.53)	0.056	(0.33)	-0.042	(-0.26)	-0.133	(-1.47)	32.3
	P1-P3	0.005*	(1.69)	0.002	(0.03)	0.078	(0.68)	-0.371***	(-3.45)	-0.331***	(-5.44)	20.6
France	P1	0.006	(1.04)	1.003***	(6.14)	-0.175	(-0.75)	0.459*	(1.66)	-0.496***	(-3.27)	53.2
	P2	0.006	(1.19)	0.999***	(7.36)	-0.098	(-0.50)	0.238	(1.03)	-0.268**	(-2.12)	54.3
	P3	0.001	(0.13)	0.883***	(5.98)	-0.277	(-1.29)	0.157	(0.62)	0.153	(1.11)	39.1
	P1-P3	0.002	(0.65)	0.081	(0.76)	0.129	(0.84)	0.173	(0.95)	-0.698***	(-7.00)	20.3
Germany	P1	0.007	(0.56)	0.441	(1.27)	-1.052**	(-2.12)	1.080*	(1.83)	-0.877***	(-2.72)	29.5
	P2	-0.001	(-0.10)	1.046***	(4.22)	-0.235	(-0.66)	-0.417	(-0.99)	-0.214	(-0.93)	32.8
	P3	-0.012	(-1.52)	0.479**	(2.32)	-0.428	(-1.50)	-0.061	(-0.17)	0.178	(0.94)	18.2
	P1-P3	0.020**	(2.41)	-0.163	(-0.72)	-0.663**	(-2.13)	1.105***	(2.89)	-1.150***	(-5.57)	23.3
Hong Kong	P1	-0.001	(-0.16)	1.290***	(12.59)	-0.051	(-0.25)	0.957***	(3.26)	-0.679***	(-4.28)	66.0
	P2	-0.002	(-0.35)	1.407***	(18.25)	-0.368**	(-2.40)	0.636***	(2.88)	-0.400***	(-3.35)	78.5
	P3	-0.005	(-0.51)	1.372***	(9.73)	-0.246	(-0.88)	0.471	(1.16)	-0.038	(-0.17)	49.2
	P1-P3	0.004	(0.66)	-0.082	(-0.97)	0.196	(1.16)	0.486**	(2.00)	-0.641***	(-4.88)	8.0
Japan	P1	0.007	(0.99)	0.799***	(7.23)	0.212	(0.96)	0.335	(1.30)	-0.409**	(-2.36)	41.9
	P2	0.001	(0.25)	0.566***	(6.60)	-0.089	(-0.52)	0.179	(0.89)	0.026	(0.19)	34.5
	P3	-0.003	(-0.42)	0.712***	(6.46)	-0.040	(-0.18)	0.511**	(1.98)	-0.083	(-0.48)	36.4
	P1-P3	0.010**	(2.55)	0.087	(1.43)	0.251**	(2.06)	-0.176	(-1.23)	-0.325***	(-3.40)	7.5

(continued on next page)

Table 2.5 *(continued)*

Netherlands	P1	0.004	(0.39)	0.784***	(2.79)	-0.733*	(-1.82)	0.389	(0.82)	-0.517*	(-1.98)	33.6
	P2	0.002	(0.57)	0.670***	(6.06)	-0.352**	(-2.23)	0.362*	(1.93)	-0.070	(-0.68)	49.3
	P3	-0.012**	(-2.48)	0.595***	(4.34)	-0.521**	(-2.68)	0.336	(1.46)	0.110	(0.87)	38.1
	P1-P3	0.015**	(2.34)	0.102	(0.60)	-0.280	(-1.15)	0.066	(0.23)	-0.665***	(-4.19)	16.3
Singapore	P1	0.011*	(1.93)	1.242***	(9.90)	-0.369**	(-2.23)	0.551**	(2.52)	-0.418***	(-3.02)	58.9
	P2	0.004	(0.93)	1.236***	(12.30)	0.035	(0.26)	0.482***	(2.75)	-0.555***	(-5.00)	70.3
	P3	-0.013**	(-2.36)	0.956***	(8.26)	-0.285*	(-1.87)	0.194	(0.97)	-0.085	(-0.67)	48.8
	P1-P3	0.023***	(6.20)	0.286***	(3.54)	-0.089	(-0.83)	0.357**	(2.55)	-0.339***	(-3.81)	9.8
Sweden	P1	0.011	(1.55)	0.781***	(3.78)	-0.794***	(-2.69)	0.542	(1.55)	0.083	(0.43)	32.7
	P2	0.009	(1.36)	0.385**	(2.04)	-0.841***	(-3.13)	0.590*	(1.85)	0.049	(0.28)	24.6
	P3	0.002	(0.29)	0.519***	(2.72)	-0.389	(-1.50)	0.575*	(1.78)	0.044	(0.27)	22.2
	P1-P3	0.008*	(2.28)	0.125	(1.15)	-0.447***	(-3.03)	0.136	(0.74)	-0.033	(-0.35)	10.8
United Kingdom	P1	0.024***	(2.92)	1.122***	(4.72)	0.768*	(1.81)	0.673*	(1.76)	-1.785***	(-8.76)	60.6
	P2	0.003	(0.76)	0.572***	(4.63)	-0.112	(-0.51)	0.439**	(2.21)	-0.539***	(-5.09)	55.5
	P3	-0.000	(-0.00)	0.595***	(3.98)	0.057	(0.21)	0.228	(0.95)	-0.219*	(-1.71)	31.5
	P1-P3	0.024***	(6.75)	0.528***	(5.12)	0.712***	(3.86)	0.445***	(2.69)	-1.566***	(-17.75)	58.1
Panel B: Global Level												
1) Absolute NAV Spread	P1	0.010**	(2.54)	1.138***	(10.89)	-0.035	(-0.19)	0.652***	(3.43)	-1.061***	(-9.77)	78.8
	P2	0.002	(0.99)	0.884***	(14.93)	-0.091	(-0.89)	0.144	(1.34)	-0.231***	(-3.76)	80.3
	P3	-0.000	(-0.12)	0.969***	(12.41)	-0.025	(-0.18)	-0.079	(-0.56)	0.040	(0.49)	69.2
	P1-P3	0.010***	(4.00)	0.179***	(2.96)	0.012	(0.11)	0.663***	(5.51)	-1.088***	(-15.97)	50.4
2) Relative NAV Spread	P1	0.012***	(3.58)	1.094***	(12.79)	0.248*	(1.68)	0.113	(0.73)	-0.613***	(-6.90)	78.3
	P2	0.002	(0.65)	0.914***	(13.48)	-0.144	(-1.23)	0.286**	(2.32)	-0.347***	(-4.92)	78.5
	P3	-0.001	(-0.22)	0.934***	(13.35)	-0.132	(-1.10)	0.054	(0.43)	-0.067	(-0.92)	74.3
	P1-P3	0.012***	(6.85)	0.148***	(3.69)	0.342***	(4.74)	0.054	(0.66)	-0.539***	(-11.91)	38.6

This table contains the risk-adjusted returns of real estate stock portfolios sorted according to their NAV discounts over the January 2005 to May 2014 period (n = 117). We obtain risk-adjusted returns (alphas) from time series regressions of the excess portfolio returns (P1, P2, P3, and P1-P3) on the excess overall market return (MKT), the global SMB risk factor, the global HML risk factor, and the global WML risk factor (the data come from Kenneth French's website, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/datalibrary.html). All returns are monthly and in local currencies. The risk-free rate is the local currency one-month T-bill rate. In panel A, the market factor is the return of the respective region provided by Kenneth French; in panel B, the market factor is the global market return provided by Kenneth French. Panel A shows the risk-adjusted returns at the individual country level. The P1 portfolio consists of the quintile of stocks with the highest NAV discounts in a given month; the P2 portfolio consists of stocks in the middle three quintiles of stocks sorted according to their NAVs; the P3 portfolio consists of stocks with the highest NAV premiums in a given month; and P1-P3 represents the long-short portfolio. Panel B shows the risk-adjusted returns at the global level. Methods (1) and (2) differ regarding the sorting procedure that is used to construct the portfolios. Method (1) sorts the global sample of stocks according to their absolute NAV spreads in a given month; method (2) sorts the global sample according to each stock's NAV spread relative to the average NAV spread in the respective country in a given month. T-statistics are in parentheses, and parameters marked ***,**, and * are significant at the 1%, 5%, and 10% levels, respectively.

Table 2.6: Risk-adjusted performance of portfolios sorted by NAV spreads (Carhart four-factor model) with yearly sorting procedure.

		Alpha		MKT		SMB		HML		WML		R^2
Panel A: Country Level												
Australia	P1	0.000	(0.07)	1.283***	(22.51)	0.063	(0.62)	0.018	(0.18)	-0.334***	(-3.99)	86.8
	P2	-0.000	(-0.14)	0.920***	(34.56)	0.088*	(1.86)	-0.026	(-0.55)	0.042	(1.09)	92.6
	P3	-0.001	(-0.25)	1.123***	(17.36)	-0.261**	(-2.27)	0.018	(0.16)	0.220**	(2.32)	77.0
	P1-P3	0.001	(0.38)	0.159***	(3.00)	0.323***	(3.42)	-0.000	(-0.01)	-0.555***	(-7.09)	24.0
Belgium	P1	0.003	(1.11)	0.895***	(14.05)	-0.053	(-0.62)	0.057	(0.55)	0.024	(0.42)	68.5
	P2	-0.002	(-1.35)	1.001***	(23.01)	-0.010	(-0.18)	-0.031	(-0.44)	-0.005	(-0.12)	85.1
	P3	0.002	(0.51)	1.147***	(12.17)	0.092	(0.73)	-0.010	(-0.06)	-0.051	(-0.59)	62.7
	P1-P3	0.001	(0.29)	-0.233***	(-3.16)	-0.138	(-1.39)	0.075	(0.62)	0.080	(1.19)	3.9
Canada	P1	0.001	(0.19)	1.084***	(15.62)	0.042	(0.37)	-0.138	(-1.26)	-0.161**	(-2.46)	79.6
	P2	-0.000	(-0.20)	0.983***	(33.93)	-0.090*	(-1.88)	0.050	(1.10)	0.072***	(2.64)	93.0
	P3	0.002	(0.66)	0.856***	(11.20)	0.218*	(1.74)	0.069	(0.58)	-0.022	(-0.31)	59.7
	P1-P3	-0.001	(-0.53)	0.229***	(3.31)	-0.176	(-1.55)	-0.207*	(-1.91)	-0.139**	(-2.13)	18.1
France	P1	0.003	(0.57)	1.117***	(13.14)	0.199	(1.09)	0.138	(0.63)	-0.283**	(-2.24)	73.1
	P2	-0.000	(-0.13)	0.968***	(33.58)	-0.103*	(-1.67)	-0.007	(-0.09)	0.065	(1.53)	94.2
	P3	-0.002	(-0.47)	1.000***	(15.39)	0.016	(0.11)	-0.052	(-0.30)	0.119	(1.22)	77.5
	P1-P3	0.005	(1.18)	0.133*	(1.92)	0.122	(0.79)	0.184	(1.02)	-0.373***	(-3.57)	9.4
Germany	P1	0.001	(0.09)	1.164***	(9.96)	0.130	(0.33)	0.238	(0.53)	-0.303	(-1.13)	57.5
	P2	-0.000	(-0.08)	1.066***	(31.27)	0.075	(0.66)	-0.157	(-1.19)	-0.002	(-0.03)	92.6
	P3	-0.010	(-1.46)	0.510***	(7.07)	-0.184	(-0.78)	0.033	(0.12)	0.281*	(1.75)	46.4
	P1-P3	0.013	(1.42)	0.742***	(7.34)	0.411	(1.24)	0.123	(0.32)	-0.529**	(-2.36)	28.1
Hong Kong	P1	0.003	(0.55)	0.796***	(16.78)	0.205	(1.37)	0.061	(0.29)	-0.228*	(-1.88)	76.4
	P2	0.001	(0.29)	1.011***	(59.78)	-0.052	(-0.98)	0.070	(0.94)	-0.052	(-1.21)	97.4
	P3	-0.000	(-0.02)	1.174***	(18.83)	-0.093	(-0.47)	-0.410	(-1.50)	0.343**	(2.15)	78.2
	P1-P3	0.003	(0.49)	-0.378***	(-6.78)	0.298*	(1.69)	0.471*	(1.93)	-0.572***	(-4.01)	14.9
Japan	P1	0.005	(1.28)	1.230***	(22.95)	0.080	(0.72)	0.022	(0.16)	-0.257***	(-2.76)	84.6
	P2	-0.000	(-0.29)	0.913***	(45.90)	-0.103**	(-2.50)	-0.074	(-1.44)	0.112***	(3.24)	95.5
	P3	-0.004	(-0.95)	1.084***	(17.76)	0.092	(0.73)	0.209	(1.32)	-0.065	(-0.62)	77.7
	P1-P3	0.009**	(2.28)	0.146***	(2.65)	-0.012	(-0.10)	-0.187	(-1.30)	-0.191**	(-2.00)	5.0

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Table 2.6 (continued)

Netherlands	P1	-0.000	(-0.00)	1.247***	(18.56)	0.321**	(2.22)	-0.193	(-1.17)	-0.053	(-0.56)	81.9
	P2	0.001	(0.58)	0.967***	(28.76)	-0.096	(-1.32)	0.043	(0.52)	-0.018	(-0.39)	92.9
	P3	-0.005	(-1.14)	0.636***	(7.73)	-0.239	(-1.36)	0.153	(0.75)	0.188	(1.65)	50.9
	P1-P3	0.003	(0.78)	0.659***	(9.79)	0.602***	(4.39)	-0.325***	(-2.05)	-0.223**	(-2.51)	32.4
Singapore	P1	0.003	(0.65)	1.088***	(18.10)	-0.218*	(-1.82)	0.018	(0.12)	0.093	(0.86)	80.3
	P2	0.001	(0.27)	0.967***	(34.67)	0.062	(1.11)	0.015	(0.23)	0.120**	(2.41)	93.4
	P3	-0.004	(-0.96)	1.001***	(15.06)	-0.010	(-0.07)	-0.199	(-1.26)	-0.436***	(-3.67)	80.3
	P1-P3	0.007*	(1.71)	0.087	(1.45)	-0.209*	(-1.74)	0.217	(1.52)	0.529***	(4.39)	10.2
Sweden	P1	-0.000	(-0.08)	1.090***	(17.89)	-0.017	(-0.11)	0.154	(0.84)	-0.118	(-1.14)	80.5
	P2	-0.000	(-0.07)	1.061***	(41.89)	0.054	(0.81)	-0.086	(-1.13)	0.048	(1.12)	95.4
	P3	-0.002	(-0.56)	0.757***	(14.25)	-0.077	(-0.59)	-0.018	(-0.12)	0.079	(0.94)	74.1
	P1-P3	0.004	(1.21)	0.312***	(5.71)	0.041	(0.30)	0.196	(1.28)	-0.211**	(-2.44)	17.1
United Kingdom	P1	0.017**	(2.62)	1.726***	(14.46)	1.047***	(3.99)	0.130	(0.47)	-1.030***	(-5.50)	83.4
	P2	-0.003*	(-1.82)	0.883***	(32.52)	-0.098	(-1.64)	0.004	(0.06)	0.110**	(2.58)	94.9
	P3	-0.005	(-1.37)	0.876***	(13.95)	-0.312**	(-2.26)	-0.023	(-0.16)	0.289***	(2.93)	76.7
	P1-P3	0.022***	(4.73)	0.850***	(10.07)	1.359***	(7.34)	0.152	(0.78)	-1.319***	(-9.96)	57.4
Panel B: Global Level												
1) Absolute NAV Spread	P1	0.001	(0.45)	1.159***	(21.15)	0.134	(1.25)	0.234**	(2.08)	-0.360***	(-5.07)	89.8
	P2	-0.000	(-0.67)	0.961***	(56.95)	-0.023	(-0.69)	-0.015	(-0.44)	0.057**	(2.62)	98.1
	P3	0.001	(0.21)	0.960***	(17.51)	-0.083	(-0.78)	-0.179	(-1.60)	0.133*	(1.89)	83.2
	P1-P3	-0.000	(-0.15)	0.198***	(3.77)	0.232**	(2.26)	0.389***	(3.48)	-0.491***	(-7.02)	25.0
2) Relative NAV Spread	P1	0.005**	(2.18)	1.062***	(21.46)	0.089	(0.92)	-0.282***	(-2.79)	0.054	(0.85)	88.5
	P2	-0.002	(-1.41)	0.985***	(40.02)	0.003	(0.06)	0.143***	(2.83)	-0.043	(-1.34)	96.3
	P3	-0.001	(-0.26)	0.983***	(20.76)	-0.130	(-1.41)	-0.134	(-1.38)	0.041	(0.68)	88.4
	P1-P3	0.006***	(3.16)	0.062*	(1.66)	0.193***	(2.65)	-0.100	(-1.23)	-0.004	(-0.07)	2.8

This table contains the risk-adjusted returns of real estate stock portfolios sorted yearly according to their NAV discounts over the January 2005 to May 2014 period (n = 117). The results are based on a yearly sorting procedure, i.e., where stocks are sorted at the end of June each year based on their NAV discount, and remain in the respective portfolio for one year. We obtain risk-adjusted returns (alphas) from time series regressions of the excess portfolio returns (P1, P2, P3, and P1-P3) on the excess benchmark portfolio (MKT) return, the global SMB risk factor, the global HML risk factor, and the global WML risk factor. All returns are monthly and in local currencies. The risk-free rate is the local currency one-month T-bill rate. In panel A, the market return is the equally weighted return of all real estate stocks of the respective country; in panel B, the market return is the equally weighted return of all global stocks. Panel A shows the risk-adjusted returns at the individual country level. The P1 portfolio consists of the quintile of stocks with the highest NAV discounts at the end of June in a given year; the P2 portfolio consists of stocks in the middle three quintiles of stocks sorted according to their NAVs; the P3 portfolio consists of stocks with the highest NAV premiums at the end of June in a given year; and P1-P3 represents the long-short portfolio. Panel B shows the risk-adjusted returns at the global level. Methods (1) and (2) differ regarding the sorting procedure that is used to construct the portfolios. Method (1) sorts the global sample of stocks according to their absolute NAV spreads at the end of June in a given year; method (2) sorts the global sample according to each stock's NAV spread relative to the average NAV spread in the respective country at the end of June in a given year. T-statistics are in parentheses, and parameters marked ***,**, and * are significant at the 1%, 5%, and 10% levels, respectively.

Chapter 3

New insights into the NAV spread puzzle of listed real estate: idiosyncratic and systematic evidence

This paper is the result of a joint project with René-Ojas Woltering.

Abstract

This paper provides new insights into the determinants of NAV spreads for listed real estate companies. Using a global sample of 447 REITs and REOCs, we find that NAV spreads are driven by interest rates, in particular the default spread. We also highlight the role of the general stock market valuations in a country, as measured by price-to-earnings or price-to-book ratios. Finally, we document substantial differences between REITs and REOCs, as well as across regions and real estate sectors. Our paper contributes to the literature on the pricing of real estate stocks, which has thus far focused on company-specific variables.

3.1 Introduction

The term NAV spread refers to deviations in share prices of listed real estate stocks (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.[18]

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) 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

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

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 3.2 reviews the related literature and introduces our hypotheses. The data and methodology are described in section 3.3, while section 3.4 describes and discusses our empirical results. Section 3.5 concludes, and offers an outlook for future studies.

3.2 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.

3.2.1 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 (2004) 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 (2000) 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 3.1: *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 (2004), 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 (2004), 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 3.2: *NAV spreads of REOCs and REITs decrease with increasing leverage and with increasing risk.*

3.2.2 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*.[19] 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 growth stocks. 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 3.3: *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).

[19] We provide a thorough definition of the two factors in the "Data and methodology" section.

Analyzing the NAV spreads of EU resident REITs, Mueller and Pfnuer (2013) confirm five implications[20] 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 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 3.4: *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.*

[20] 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).

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.

3.3 Data and methodology

3.3.1 Sample description

We choose our sample based on the constituents of the FTSE EPRA/NAREIT Global Real Estate Index.[21] 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,[22] and 4) publication of audited annual accounting reports in English.[23]

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,[24] 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 (2011), our study is one of the few to apply firm-level data. Yavas and Yildirim (2011) argue that firm-level data is advantageous when performing causality and correlation tests in a NAV spread context.

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

3.3.2 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 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 spread:

$$NAV\ spread_{i,t} = \frac{Price_{i,t}}{NAV_{i,t}} - 1 \qquad \text{(Eq. 3.1)}$$

with $NAV\ spread_{i,t} > 0$ *= NAV premium, and*

$NAV\ spread_{i,t} < 0$ *= NAV discount.*

3.3.3 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 3.1, 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 3.2, 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 (e.g., rental income). 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:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_{iM,t}\left[R_{m,t} - R_{f,t}\right] + \varepsilon_{i,t} \quad \text{(Eq. 3.2)}$$

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 3.2, 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 monetary 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:

$$DEF_{j,t} = CBY_{j,t} - LTIR_{j,t} \quad \text{(Eq. 3.3)}$$

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 3.3 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:

$$TERM_{j,t} = LTIR_{j,t} - STIR_{j,t} \quad \text{(Eq. 3.4)}$$

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 (+) accordingly.

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 did not 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 3.4, 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:

$$BA\_Spr_{i,t} = \frac{AskPrice_{i,t} - BidPrice_{i,t}}{AskPrice_{i,t}} * 100 \qquad \text{(Eq. 3.5)}$$

Note that an increasing bid-ask spread signals decreased liquidity. Thus, in accordance with Hypothesis 3.2, 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 (+).

3.3.4 Empirical model

To test Hypotheses 3.1-3.4 and the effect of the presented idiosyncratic and systematic factors on NAV spreads of individual stocks, we run the following panel regression model:

$$NAV\ Spread_{i,t} = \alpha_i + \beta_1 SIZE_{i,t} + \beta_2 LEV_{i,t} + \beta_3 ICR_{i,t} + \beta_4 BETA_{i,t} + \beta_5 \Delta DEF_{j,t} + \beta_6 \Delta TERM_{j,t} + \beta_7 PTB\_ctr_{j,t-1} + \beta_8 PEr\_ctr_{j,t-1} + \beta_9 Sector\_Spr_{j,t-1} + \varepsilon_{i,t} \quad \text{(Eq. 3.6)}$$

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

We consider Eq. 3.6 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 term Eq. 3.7 our "control model":

$$NAV\ Spread_{i,t} = \alpha_i + \beta_1 SIZE_{i,t} + \beta_2 LEV_{i,t} + \beta_3 ICR_{i,t} + \beta_4 BETA_{i,t} + \beta_5 \Delta DEF_{j,t} + \beta_6 \Delta TERM_{j,t} + \beta_7 PTB\_ctr_{j,t-1} + \beta_8 PEr\_ctr_{j,t-1} + \beta_9 SectorSpr_{j,t-1} + \boldsymbol{\beta_{10} TAXRt_{i,t}} + \boldsymbol{\beta_{11} BA\_Spr_{i,t}} + \boldsymbol{\beta_{12} PEratio_{i,t}} + \boldsymbol{\beta_{13} NAVgrowth_{i,t}} + \varepsilon_{i,t} \quad \text{(Eq. 3.7)}$$

with 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) sectoral focus, and 4) strategy. Previous studies have analyzed subpanels along various dimensions: REIT status (Bond and Shilling, 2004; 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.

3.4 Empirical results

3.4.1 Summary statistics

Table 3.1 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 1.97, which is higher[25] than the average real estate sector spread (0.68). Moreover, the marketwide price-earnings ratio (**PE_ratio**) is considerably smaller than the price-earnings ratio (**PEratio**) of the individual REOCs and REITs.

[25] 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).

Table 3.1: 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 3.2 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.

Table 3.2: 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.

3.4.2 Regression results

Overall results

Table 3.3 reports the panel regression results of the main model, which are shown in column (4). Except for LEV, the coefficients of 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, increasing risk (BETA) decreases NAV spreads and thus increases discounts. The results for LEV are contrary to Hypothesis 3.2, 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 3.3 and rather unanticipated. The stepwise regressions of models 1-3 in Table 3.3 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 3.4. That is, NAV spreads accompany increasing sectorwide and marketwide real estate price-earnings ratios.

Table 3.3: 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 Eq. 3.2. 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 3.4 reports the results for the control model (small sample) with four additional idiosyncratic factors. The results are generally in line with Table 3.3 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.

Table 3.4: 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 Eq. 3.3. 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.

Subpanel evidence

Table 3.5 and Table 3.6 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.

Table 3.5: Panel regression results | main model | subpanels 1 and 2.

	SUBPANEL 1: *REIT STATUS*		**SUBPANEL 2: *REGIONS***		
	(1) REITs	(2) REOCs	(1) Europe	(2) North America	(3) 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 3.6: 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.

3.4.3 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).[26]

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[27] are cointegrated in the long run, and exhibit a mean-reverting relationship. However, they cannot ascertain the average time lapse or speed of stock 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

[26] Capital market channel (stock price), company channel (operating performance), and property channel (underlying real estate properties/NAV).

[27] Stock prices in eight Asian-Pacific-listed real estate markets between 1995 and 2003.

and Ward (1999), who conclude that NAV spreads exist because of 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 affects 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 merely 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.[28] 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.

3.5 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 3.2, 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.

[28] We thank the participants of the Uni Regensburg / Uni Constance doctoral seminar for raising this question.

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 improved 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.

Chapter 4

The interest rate sensitivities of value and growth stocks: evidence from listed real estate companies

This paper is the result of a joint project with René-Ojas Woltering and Steffen Sebastian.

Abstract

This paper analyzes the return sensitivities of value and growth stocks to changes in five interest rate proxies. Using a global sample of 352 listed real estate companies from 12 countries as a test object, we find that value stocks are more sensitive than growth stocks to changes in the short-term interest rate. This is consistent with the theory that investors with shorter investment horizons trade off the high initial yield of value stocks against lower-risk short-term interest rates. In contrast, growth stocks are more sensitive to changes in the long-term interest rate, which is consistent with a stronger impact on the present value of the future cash flows of growth stocks. We also find that value stocks are more sensitive to changes in the credit yield. Because credit costs have a direct impact on a firm's cost of capital, this result is consistent with risk-based theories of the value premium, which argue value stocks are riskier because they tend to have higher leverage and greater default probability.

4.1 Introduction

This paper systematically analyzes whether, and to what extent, the performance of real estate value and growth stocks can be explained by five different interest rate proxies. The five factors are: changes in short-term interest rates (STIR), long-term interest rates (LTIR), term spreads (TERM), corporate bond yields (CBY), and default spreads (DEF). Our empirical analysis is based on a global panel of 352 listed real estate companies in 12 countries over the 2005-2014 period.

The innovative contribution of this paper lies within the particular panel selection as a test object. The concept of controlling for interest rate changes in the context of real estate value and growth stocks is unique and differs from the traditional value and growth stock literature. But why shall listed real estate be particularly suited to study deviations between fundamental value and stock price and furthermore innovate the findings of existing research?

1) The business model of real estate companies differs from the characteristics of other industries like technology, consumer goods, energy or healthcare. Because of their peculiar characteristics, listed real estate companies are particularly well-suited to studying the impact of interest rate changes. There are three obvious channels through which interest rates may impact the stock market returns of listed real estate companies: the relative attractiveness of equities compared to other asset classes such as fixed income or the money market (capital market channel). The real estate company's operating performance (corporate channel), by influencing a firm's debt costs. And, the underlying properties (property channel) whose values are determined based on discount rates, which are yet derived from the anticipated interest rate level (risk-free rate).

2) We follow the concept of Woltering et al (2018) who use the net asset values (NAVs) of property-holding companies in countries with fair value-based accounting regimes as a more reliable indicator of fundamental value. Existing research differentiates value and growth stocks usually according to their book-to-market ratios of equity. IFRS accounting requires reporting assets at their fair value. The cash flows of property-holding companies are strongly reliant on rental income and the assets consist primarily of regularly appraised property values. Woltering et al (2018) argue that under the assumption that other assets and liabilities of the company are also reported close to market value, the book value of equity (or the net asset value (NAV)) of property-holding companies represents a "sum of the parts" valuation of the company, where each property is appraised using property-specific risk-adjusted discount rates. This provides a unique setting to study discrepancies between market prices and estimates of intrinsic value as well as their sensitivity to interest rate changes.

Furthermore, our data setting offers substantial heterogeneity in interest rates across time and countries and thus, together with the aforementioned contribution, fills in a research gap in the literature on value and growth stocks.

The clear paths through which interest rates can affect real estate stocks, combined with the ability to reliably distinguish between value and growth stocks, provide an ideal research setting from which to explore the relationships between various interest rates and stock market returns. The corresponding research question is: Do the returns of value and growth stocks react differently to changes in various interest rate proxies?

Our empirical approach is based on panel regressions at the level of individual stocks. To examine the diverging interest rate sensitivities of value and growth stocks, we regress stock returns on the respective interest rate proxy as well as an interaction term between the interest rate proxy and a value or growth indicator variable. Stocks are grouped into value or growth based on monthly rankings according a stock`s deviation from its NAV. Value stocks are those who belong to the quintile of stocks with the highest discount to NAV. Our panel regressions control for common risk factors (Carhart, 1997).

We find that value stocks are more sensitive to changes in the short-term interest rate, the corporate bond yield, and the default spread. In contrast, growth stocks are more sensitive to changes in long-term interest rates and the term spread. To the best of our knowledge, this is the first paper to examine the diverging interest rate sensitivities of value and growth stocks in a listed real estate context. Furthermore, this is the first paper to address interest rate sensitivities in a NAV context in a global setting.

The remainder of this paper is organized as follows. Section 4.2 reviews the related literature and introduces our hypotheses. The data and methodology are described in section 4.3, while section 4.4 describes our empirical results. Section 4.5 discusses the findings and concludes.

4.2 Related Literature and Hypotheses

4.2.1 The Interest Rate Sensitivity of Stocks Returns

Numerous studies analyze the interest rate sensitivity of stock returns. Stone (1974) and Lloyd and Shick (1977) use a two-index version of the CAPM (market and interest rate terms) in their analyses. Fama and Schwert (1977) demonstrate that monthly changes in short-term interest rates have a negative impact on the returns of commons stocks. Several other studies follow a similar methodological approach, and focus on financial institutions (see, e.g., Chance and Lane, 1980; Lynge and Zumwalt, 1980; Flannery and James, 1984; Bae, 1990; and Elyasiani and Mansur, 1998). In addition to financial institutions, many studies also focus on the interest rate sensitivity of listed real estate companies such as real estate investment trusts (REITs) and real estate operating companies (REOCs). As these companies are concerned with the ownership and operation of direct real estate holdings, they are particularly suited to analyze the impact of interest rate changes. Lizieri and Satchell (1997) and Lizieri et al. (1998) argue that listed real estate companies are affected by interest rate changes on two further levels than the stock market: First, the "*underlying direct [real estate] market"* level, which is represented by the NAV appraised on a discounted cash flow basis. As interest rates rise, the capital values of individual properties become depressed. Second, the corporate level of real estate companies, which is characterized by high leverage and decreasing profits because the costs of borrowing increase when interest rates rise.

Chen and Tzang (1988) and Allen et al. (2000) find that U.S. REITs are sensitive to changes in short- and long-term interest rates. Consistent with these findings, Devaney (2001) reports a highly significant and negative coefficient for monthly changes in long-term interest rates that can explain the excess returns of U.S. REITs between 1978 and 1998. In contrast, Liang et al. (1995) find no significant interest rate risk factor for equity REITs. Similarly to He et al. (2003) and Swanson et al. (2002), they use default and term spreads as interest rate proxies. Their empirical results reveal that REIT returns are more sensitive to changes in the term spread than the default spread.

Akimov et al. (2015) is one of the few studies that analyzes global listed real estate markets, but with index-level data rather than more precise panel data. The authors demonstrate the importance of interest rate risk for listed real estate companies. In line with most prior research, they find that short- and long-term interest rates are significant risk factors in explaining the returns of listed real estate.

In summary, due to their peculiar characteristics, real estate stocks are fruitful to study the interest rate sensitivity of stocks. Thus far, the real estate strand of the literature on the interest rate sensitivity of stock returns tends to focus on index-level data, or observations from individual countries. In this study we use a more refined panel data approach of individual real estate stocks returns from 12 countries.

4.2.2 Value vs Growth

The literature on the value premium suggests that there is a systematic difference between the financial characteristics of value and growth stocks. This raises the question whether value and growth stocks also react differently to interest rate changes. As our hypotheses are based on the fundamental differences between value and growth stocks, the respective literature is reviewed in this section.

Fama's (1970) seminal efficient market hypothesis (EMH) posits that financial markets *"at any time 'fully reflect' all available information,"* including the intrinsic value of a listed company. Shiller (1981), however, contradicts the EMH by documenting that a substantial portion of stock volatility is unexplained by changes in fundamental information (e.g., future dividends). Another seminal theory, the capital asset pricing model (CAPM) of Sharpe (1964) and Lintner (1965), fails to describe such return anomalies. These anomalies include, e.g., that market portfolios do not entirely explain the relevant risk in the economy to expected returns (Lewellen 1999), such as overreactions to new financial information (De Bondt and Thaler, 1985).

Another return anomaly is tied to the work of Rosenberg et al. (1985) and Fama and French (2012), who find that stocks with high book-to-market ratios of equity have higher returns than those with low ratios (the value premium). Fama and French (1992) address this shortcoming by extending the CAPM by two additional risk factors, size and book-to-market. They provide evidence that the three-factor model has increasing explanatory power and can explain risk in expected returns more precisely.

The literature on the explanation of the value premium can be separated into two strands. The behaviorist approach argues that the value premium is a result of suboptimal investor behavior (e.g., Lakonishok et al., 1994; De Bondt and Thaler, 1985). In contrast, risk-based explanations for the value premium argue that stock-specific fundamentals such as a firm`s leverage or size are causing the average outperformance of value stocks (e.g., Davis et al., 2000; Zhang, 2005; Liew and Vassalou, 2000).

Another approach includes macroeconomic factors, or risk-based explanations involving systematic risk. The rationale behind this approach is that value stocks are particularly prone to macroeconomic risk factors, and thereby justify a risk premium. Lewellen (1999) finds that value stocks are sensitive to changing macroeconomic conditions, which is consistent with the "distress factor" suggested by Fama and French (1993). Jensen and Mercer (2002) provide evidence that monetary policy is an important additional factor in explaining the risk premia of the three-factor model.

Hahn and Lee (2006) extend the three-factor model of Fama and French (1993) by two additional macroeconomic variables, based on the proposition that market, size, and book-to-market do not fully proxy for systematic risk and business cycle fluctuations. The two additional factors are the *default spread* and the *term spread*. These yield spreads are commonly used as proxies for credit market and monetary policy conditions.

Thus far, however, only few studies analyze potential differences between the interest rate sensitivity of value and growth stocks. Hahn and Lee (2006) find that value stocks have higher (positive) loadings on positive changes in the term spread than on growth stocks. Other studies provide evidence that the returns of value stocks are related to macroeconomic state variables, such as, e.g., consumption growth (Kang et al., 2011) and marketwide fluctuations in expected cash flows (Da and Warachka, 2009). Lioui and Maio (2014) use a macroeconomic asset pricing model, and find that value stocks have higher interest rate risk than growth stocks. They conclude that interest rate risk is a key factor in explaining the value premium. In their empirical analysis, they note that value stocks load negatively on the monetary factor, represented by the short-term interest rate (STIR) and the effective federal funds rate as interest rate proxies.

4.2.3 Short-term Interest Rates and Relative Attractiveness

We build up on the findings of Lioui and Maio (2014), and analyze the impact of short term interest rates on value and growth stocks in the context of listed real estate. In doing so, we use the concept of *relative attractiveness* between asset classes. Investors are constantly confronted with diverse investment opportunities from different asset classes, whose financial characteristics are subject to continuous change. For example, yield-focused investors with a rather short-term investment horizon may invest in money market related investment products whose returns are linked to the short-term interest rate. Alternatively, these investors could invest in stocks which promise to pay a high and consistent dividend yield.

On average, value stocks have higher dividend yields than growth stocks, since a high book-to-market ratio corresponds with a low price-to-earnings ratio and also a higher dividend yield. Hence, investors with a short investment horizon are more likely to choose between an investment in the short-term interest rate and value stocks as opposed to growth stocks with lower or no dividends at all.

As the short-term interest rate falls, the relative attractiveness between both asset classes changes, resulting in a potential rotation towards value stocks, because they provide them with a higher relative yield than before the drop in interest rates. Due to the relatively low dividend yield of growth stocks, their returns would be driven to a lesser extent by this consideration as compared to value stocks.

In summary, we expect value stocks to be positively related to a drop in short-term interest rates and negatively related to an increase in short-term interest rates. Growth stocks, however, would be driven to a lesser extent by changes in the short-term interest rate. Considering this hypothesized effect of the capital market channel, we formulate our first hypothesis as follows:

Hypothesis 4.1: *The risk-adjusted returns of value stocks are more sensitive to changes in short-term interest rates than those of growth stocks.*

4.2.4 Long-term Interest Rates and Discounted Cash Flows

According to Campbell and Viceira (2001), long-term bonds tend to be held by risk-averse investors with a long-term investment horizon seeking stable cash flows and a term premium over short-term bonds. Listed real estate companies, particularly REITs, have long been praised as a bond-like investment due to their high cash flow stability. In this section, we hypothesize whether value or growth stocks are more sensitive to changes in long-term interest rates (LTIRs).

The expected future cash flows of growth stocks tend to be leaned towards the future. In contrast, value stocks have relatively high current cash flows, but the growth expectations of value stocks are by definition smaller as compared to those of growth stocks. A common method to determine the fundamental value of a stock is to calculate the present value of its future cash flows. The discount rate that is commonly used in discounted cash flow (DCF) valuations typically consists of a risk free rate that corresponds to the length of the investment horizon and a reasonable risk premium. Long term government bond yields are a typical proxy for the risk free rate. Hence, increasing LTIRs result in higher discount rates (Thorbecke, 1997).

To the extent that stock prices are linked to fundamental values, changes of LTIRs should have a stronger impact on the prices of growth stocks as compared to value stocks. We formulate our second hypothesis accordingly:

Hypothesis 4.2: *The risk-adjusted returns of growth stocks are more sensitive to changes in long-term interest rates than those of value stocks.*

Similarly, a widening term spread, i.e., the difference between short- and long-term interest rates, decreases the relative attractiveness of growth stocks over value stocks. Hence, growth stocks should also be more sensitive than value stocks to changes in the term spread.

4.2.5 Corporate Bond Yields and the Cost of Debt

Corporate bonds are a major form of debt financing for listed real estate companies. He et al. (2003) find that changes in high-yield corporate bonds have the strongest explanatory power in explaining the returns of U.S. REITs compared to other interest rate proxies. However, is there a difference between the corporate bond sensitivities of value stocks and growth stocks?

Increasing corporate bond yields lead to higher costs of debt, which directly impacts a firm`s operating performance. Hahn and Lee (2006) argue that value stocks tend to be more highly leveraged than growth stocks. Thus, increasing corporate bond yields should have a stronger impact on the returns of value stocks as opposed to growth stocks (a similar argument is made by Bernanke and Gertler, 1995). Thus, we formulate our third hypothesis as follows:

Hypothesis 4.3: *The risk-adjusted returns of value stocks are more sensitive to changes in corporate bond yields than those of growth stocks.*

Related to the corporate bond yield is the default spread, which is defined as the difference between the corporate bond yield and the long-term interest rate. Fama and French (1989) argue that the default spread is an indicator of long-term business conditions, and is associated with high expected returns around business cycle busts and low expected returns around booms. Hence, value stocks should also be more sensitive than growth stocks to changes in the default spread.

4.3 Data and Methodology

4.3.1 Sample Description

Our sample is based on the FTSE EPRA/NAREIT Global Real Estate Index, which is comprised of listed companies with *"relevant real estate activities."* Four ground rules regarding the constituents 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,[29] and 4) publication of audited annual accounting reports in English.[30]
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 every month of the period. Our final sample consists of 352 stocks from 12 countries, and includes 278 REITs and 74 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).

4.3.2 Derivation of NAV per Share

The NAV per share (or the book value of equity) is calculated 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.
We limit our sample (except for U.S. data) 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 countries. IFRS accounting emphasizes reporting assets at their fair value, in contrast to historical cost-based accounting regimes. 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 the 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 generally reported at historical costs as opposed to fair value. Thus, for real estate stocks from the U.S., instead of book values, we obtain NAV estimates from SNL Financial. These historical NAV estimates are calculated as the average NAV estimate from all analysts that cover a specific real estate stock. Thus, for the U.S. sample, the NAV estimates are

[29] Defined as "the ownership, trading and development of income-producing real estate."
[30] http://www.epra.com/research-and-indices/indices/.

updated even more frequently than those for the IFRS countries, which are updated only when new quarterly reports are issued.

4.3.3 Classification of Value and Growth Stocks

In order to group the sample into value and growth stocks, we sort all stocks in each month according to their price deviations from NAV. Because stocks may also trade at a premium to NAV, we name our sorting criteria “NAV spread”:

$$NAV\ spread_{i,t} = \frac{Price_{i,t}}{NAV_{i,t}} - 1 \qquad \text{(Eq. 4.1)}$$

The major shortcoming of sorting value and growth stocks according to the absolute NAV spread is that it can be overly exposed to country risk. For example, if a whole country is trading at depressed levels relative to other countries, a stock that would be a growth stock on a country basis may be classified as a value stock on a global basis. To avoid this shortcoming, we follow Woltering et al. (2018) and sort stocks according to the *relative* NAV spread of stock *i* with respect to the average NAV spread of country *j* in a given month *t*:

$$Relative\ NAV\ spread_{i,j,t} = NAV\ spread_{i,j,t} - Average\ Country\ NAV\ spread_{j,t} \qquad \text{(Eq. 4.2)}$$

Value stocks are defined as the quintile with the highest discount to NAV, and growth stocks are defined as the quintile with the highest NAV premiums. To ensure the results are not biased by exchange rate fluctuations, all returns are denominated in local currencies.

Note that, in contrast to the majority of existing asset pricing studies, we follow a monthly sorting procedure based on Datastream's *"Earnings per share report date (EPS)."* We can thus ensure that financial reporting data is actually published as the stocks are grouped into value and growth. For example, if the annual report for calendar year 2013 is published in April 2014, Datastream will report a new book value of equity from December 2013 onward. But we can shift this information by four months by using the EPS report date. Financial reporting frequency is generally semiannual and may even be quarterly. Thus, NAVs may only change semiannually, but we observe monthly changes in the book-to-market ratios due to share price fluctuations.

4.3.4 Interest Rate Proxies

We categorize the interest rate proxies used in previous studies into three primary groups: 1) short- and long-term interest rates, as represented by T-bill rates and government bond yields with diverse maturities (e.g., ten to fifteen years), 2) corporate bond yields, and 3) yield spreads (e.g., the default and term spread). However, the choice of an interest rate proxy in these studies is inconsistent. As per Akimov et al. (2015), the rationale behind the proxy selection is relatively random, and the proxies cannot be incorporated into a model simultaneously. To address this issue, we consider the entire set of interest rate proxies in our study. Moreover, we make use of the default spread and the term spread because they allow us to simultaneously test the effect of more than one interest rate proxy in a single model.

Panel regression analysis enables us to estimate interest rate sensitivities on an individual stock level. We use five interest rate proxies, which each correspond to the 12 countries in our sample. With regard to selecting appropriate proxies, we follow previous research on interest rate sensitivities (e.g., He et al., 2003; Hahn and Lee, 2006; Allen et al., 2000; Jensen and Mercer, 2002).

The short-term interest rate *(STIR)* is represented by the one-year deposit rate in each individual country, the long-term interest rate (*LTIR)* is represented by the ten-year government bond yield, and the corporate bond yield (*CBY)* by the redemption yield of quality (investment-grade) corporate bonds. Following Hahn and Lee (2006) and He et al. (2003), the default spread (*DEF*) and the term spread (*TERM*) of country *j* in month *t* are calculated as follows:

$$DEF_{j,t} = CBY_{j,t} - LTIR_{j,t} \qquad \text{(Eq. 4.3)}$$

$$TERM_{j,t} = LTIR_{j,t} - STIR_{j,t} \qquad \text{(Eq. 4.4)}$$

The interest rate proxies come from 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.

4.3.5 Methodology: Modeling the Interest Rate Sensitivities of Value and Growth Stocks

To determine the interest rate sensitivity, we run the following regression at the level of individual stocks. To estimate the potential differences in interest rate sensitivities, we include three interaction terms between the interest rate proxy and the value, mid, and growth indicator variable:

$$R_{i,t} - RF_t = \alpha + \beta_1 \Delta IR_t + \beta_2 (RM_t - RF_t) + \beta_3 SMB_t + \beta_4 HML_t + \beta_5 WML_t + \beta_6 \left(Value_{i,t} * \Delta IR_{j,t}\right) + \beta_7 \left(Mid_{i,t} * \Delta IR_{j,t}\right) + \beta_8 \left(Growth_{i,t} * \Delta IR_{j,t}\right) + \beta_9 Value_{i,t} + \beta_{10} Mid_{i,t} + \beta_{11} Growth_{i,t}$$

(Eq. 4.5)

where $R_{i,t} - RF_t$ is the total return of stock i in month t in excess of the one-month risk-free rate; ΔIR_t is the first difference of the respective interest rate proxy in month t: *STIR, LTIR, CBY, DEF, or TERM*; $RM_t - RF_t$ is the market return in excess of the risk-free rate; *SMB* is the size factor; *HML* is the book-to-market factor; and WML is the momentum factor. *Value*, *Mid*, and *Growth* represent indicator variables that equal 1 if a stock is assigned to the respective group in month t. $Value_{i,t} * \Delta IR_t$, $Mid_{i,t} * \Delta IR_t$, and $Growth_{i,t} * \Delta IR_t$ are the interaction terms between the interest rate proxy and the respective indicator variables.

We obtain the four risk factors, RM, SMB, HML, and WML, from Kenneth French's website.[31] French's data library provides regional factors in USD for "Asia Pacific ex Japan," "Europe," "Japan," and "North America," so we convert the regional USD returns into local currency returns for each country. Note that RM, SMB, HML, and WML are not limited to the subsector of listed real estate. We specifically follow that convention in order to reflect the original rationale of the Carhart (1997) four-factor model, which implies that the risk factors are marketwide and are not industry-specific proxies for non-diversifiable factor risk. As our analysis is conducted at a global level, we use global RM, SMB, HML, and WML factors.

To test Hypotheses 4.1-4.3, we also directly control for differences between the interest rate sensitivities of value and growth stocks by reducing the entire sample to value and growth stocks and then establishing the following panel regression model:

$$R_{i,t} - RF_t = \alpha + \beta_1 \Delta IR_t + \beta_2 (RM_t - RF_t) + \beta_3 SMB_t + \beta_4 HML_t + \beta_5 WML_t + \beta_6 \left(Value_{i,t} * \Delta IR_{j,t}\right) + \beta_7 Value_{i,t} \qquad \text{(Eq. 4.6)}$$

In this model our primary interest is the interaction term $Value_{i,t} * \Delta IR_t$. The sign and significance of the coefficient β_6 in Equation (4.6) indicate whether value stocks are more or less sensitive than growth stocks to changes in the five interest rate proxies. 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 fixed effects estimation should be preferred over a random effects specification.

4.3.6 Summary Statistics

Table 4.1 contains the summary statistics of key variables such as returns and (relative) NAV spreads for our global sample over the 2005-2014 period. Columns 2-4 give the statistics for the value, middle, and growth stocks, respectively. On average, the monthly return of value stocks (1.48%) is notably higher than that of growth stocks (0.49%), indicating a value premium. The standard deviation reveals that value stocks are riskier than growth stocks, which is in line with previous research (e.g., Rosenberg et al., 1985). The average monthly performance of the total sample is 0.97% per month (12.28% p.a.), and it trades at an average discount to relative NAV of -0.05.

[31] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/datalibrary.html.

The summary statistics for the five interest rate proxies (rows 3-7) are in line with economic intuition. On average, LTIRs are approx. 0.80% higher p.a. than STIRs. However, LTIRs exhibit less risk from a volatility standpoint. Corporate bonds outperform both STIRs and LTIRs. The corporate bond yield exhibits risk levels similar to those of short-term rates.

Table 4.1: Summary Statistics of Value, Middle, and Growth Portfolios.

	Total	Value	Middle	Growth
1. Total Return (monthly)				
Mean	0.97	1.48	0.98	0.49
Median	1.1	1.01	1.21	0.92
Std. Dev.	10.8	12.78	10.56	9.4
Min	-97.9	-73.48	-97.9	-60.5
Max	343.07	343.07	236.42	64.63
N	23209	4431	13856	4922
2. NAV Spread				
Mean	0.21	-0.01	0.01	0.98
Median	0.04	-0.10	-0.01	0.45
Std. Dev.	0.92	0.69	0.33	1.59
Min	-0.99	-0.99	-0.96	-0.98
Max	10	10	6.81	10
N	23209	4431	13856	4922
2a. Rel. NAV Spread				
Mean	-0.05	-2.81	-0.08	2.5
Median	0.0	-0.63	-0.03	0.37
Std. Dev.	21.92	10.02	0.97	46.46
Min	-72.36	-72.36	-53.1	-54.72
Max	1773.61	11.46	6.72	1773.61
N	23209	4431	13856	4922
3. STIR				
Mean	2.34	1.96	2.51	2.2
Median	1.36	1.34	1.41	1.2
Std. Dev.	1.93	1.68	2	1.9
Min	0.04	0.04	0.04	0.04
Max	8.47	8.39	8.47	8.47
N	23209	4431	13856	4922
4. LTIR				
Mean	3.11	2.76	3.27	2.97
Median	3.12	2.7	3.31	2.91
Std. Dev.	1.28	1.25	1.25	1.31
Min	0.49	0.49	0.49	0.49
Max	6.59	6.29	6.59	6.59
N	23209	4431	13856	4922
5. CBY				
Mean	5.01	4.81	5.06	5.04
Median	4.87	4.76	4.92	4.86
Std. Dev.	2.78	3.22	2.51	3.04
Min	0.47	0.47	0.47	0.47
Max	24.75	24.75	24.75	24.75
N	23209	4431	13856	4922
6. DEF				
Mean	1.9	2.05	1.8	2.08
Median	1.13	1.3	1.06	1.18
Std. Dev.	2.52	2.84	2.29	2.79
Min	-0.89	-0.89	-0.89	-0.89
Max	22.81	22.81	22.81	22.81
N	23209	4431	13856	4922
7. TERM				
Mean	0.77	0.8	0.76	0.77
Median	0.68	0.66	0.69	0.69
Std. Dev.	1.08	0.99	1.12	1.05
Min	-2.43	-2.43	-2.43	-2.43
Max	3.56	3.56	3.56	3.56
N	23209	4431	13856	4922

This table contains the summary statistics of total returns, relative NAV spreads, and the five interest rate proxies for the global sample of listed real estate stocks over the 2005:01 to 2014:05 period. Variables 1-2a are based on monthly data and percent (%), while statistics 3-7 are based on yearly data and percent (%).

Table 4.2 contains the contemporaneous correlation coefficients of returns, relative NAV spreads, and the five interest rate proxies.

Table 4.2: Correlations Among Returns, Relative NAV Spreads, and Interest Rate Proxies.

	TR	Rel. NAVS	STIR	LTIR	CBY	DEF	TERM
Panel A: Contemporaneous correlations							
Total Return	1.00	-	-	-	-	-	-
Rel. NAV Spread	0.00	1.00	-	-	-	-	-
STIR	-0.09***	-0.00	1.00	-	-	-	-
LTIR	-0.05***	-0.00	0.85***	1.00	-	-	-
CBY	-0.07***	-0.00	0.40***	0.43***	1.00	-	-
DEF	-0.05***	-0.00	0.01	-0.04***	0.89***	1.00	-
TERM	0.10***	-0.00	-0.78***	-0.34***	-0.21***	-0.06***	1.00
Panel B: Lagged correlations							
$Total\ Return_{t-1}$	0.04***	0.00	-0.07***	-0.01	-0.09***	-0.10***	0.12***
$Rel.NAV\ Spread_{\ t-1}$	0.00	0.84***	-0.00	-0.00	-0.00	-0.00	-0.00
$STIR_{t-1}$	-0.09***	0.00	0.99***	0.84***	0.42***	0.04***	-0.78***
$LTIR_{t-1}$	-0.06***	0.00	0.85***	0.99***	0.43***	-0.02**	-0.36***
CBY_{t-1}	0.01	0.00	0.37***	0.41***	0.96***	0.85***	-0.18***
DEF_{t-1}	0.04***	0.00	-0.03***	-0.05***	0.84***	0.95***	-0.01
$TERM_{t-1}$	0.09***	-0.00	-0.76***	-0.35***	-0.24***	-0.09***	0.96***

This table shows the correlation coefficients among total returns, relative NAV spreads, and interest rate proxies for the global sample of listed real estate stocks over the 2005:01 to 2014:05 period. All statistics are based on monthly data. Panel A contains the contemporaneous correlations; panel B contains the lagged correlations.

4.4 Regression Results

Tables 4.3-4.7 contain the regression results for our five interest rate proxies (STIR, LTIR, CBY, DEF, and TERM) that are used to test Hypotheses 4.1-4.3. The tables are structured as follows: Model 1 is the base model, which estimates the general sensitivity of returns to the respective interest rate proxy. The next three models extend the base model by successively including interaction terms between the interest rate proxy and the value (model 2), middle (model 3), and growth (model 4) indicator variable. Model 5 directly tests for differences in the interest rate sensitivities of value vs. growth stocks by excluding middle stocks. Our empirical evidence regarding our hypotheses is primarily based on the interaction term between the respective interest rate proxy and the value indicator variable in model 5 of each table.

Table 4.3 contains our results for short-term interest rates (STIR). On average, the returns of real estate stocks are not sensitive with respect to changes in the STIR, as the coefficient on ΔSTIR is not statistically significant. However, the coefficient on the value interaction term is negative and statistically significant at the 1% level. This suggests that the returns of value stocks are more sensitive to changes in STIRs than all other stocks. In contrast, the coefficient on the interaction term between growth stocks and interest rate changes in model 4 is positive and significant. This suggests that growth stocks positively react to changes in the STIR. A potential explanation is that short term interest rate increases are associated with an improved economic outlook and hence more optimistic expectations regarding the growth potential of future cash flows.

But to what extent are value stocks more sensitive to an increase in the STIR compared to growth stocks? The regression result in model 5 is based on a reduced sample that consists only of value and growth stocks. Thus, the coefficient on the value interaction term provides a direct test of the difference in the interest rate sensitivity between value and growth stocks. The coefficient on interaction term between value and STIR is -2.44, and is statistically significant at the 5% level. In other words, for a 100-basis point increase in the STIR, the returns of value stocks on average fall by 244 basis points more than growth stocks. This result is not only statistically, but also economically significant.

In summary, the results in Table 4.3 are consistent with Hypothesis 4.1, the risk-adjusted returns of value stocks are more sensitive than growth stocks to changes in STIRs. A potential explanation for the stronger impact of an increase of the STIR on value stocks is that investors with a short-term investment horizon may rotate out of dividend stocks into now higher yielding investments in the short term interest rate.

Table 4.3: Short-term Interest Rate Sensitivity of Value and Growth Stocks.

	(1)	(2)	(3)	(4)	(5)
$\Delta STIR_{i,t}$	0.27	0.60*	0.22	-0.03	1.24*
	(1.17)	(2.37)	(0.57)	(-0.11)	(2.25)
$\Delta STIR_{i,t} * D\_Value_{i,t}$	-	-2.12***	-	-	-2.44**
	-	(-3.30)	-	-	(-2.93)
$\Delta STIR_{i,t} * D\_Mid_{i,t}$	-	-	0.08	-	-
	-	-	(0.16)	-	-
$\Delta STIR_{i,t} * D\_Growth_{i,t}$	-	-	-	1.71**	-
	-	-	-	(2.91)	-
$D\_Value_{i,t}$	-	0.01***	-	-	0.02***
	-	(6.29)	-	-	(4.95)
$D\_Mid_{i,t}$	-	-	0.00	-	-
	-	-	(0.83)	-	-
$D\_Growth_{i,t}$	-	-	-	-0.02***	-
	-	-	-	(-7.65)	-
$RM_{i,t}$	1.01***	1.01***	1.01***	1.01***	0.99***
	(83.20)	(83.02)	(83.15)	(83.24)	(53.24)
$SMB_{i,t}$	-0.05*	-0.05*	-0.05*	-0.05*	-0.07*
	(-2.41)	(-2.52)	(-2.42)	(-2.48)	(-2.19)
$HML_{i,t}$	0.34***	0.34***	0.34***	0.34***	0.31***
	(15.44)	(15.31)	(15.45)	(15.45)	(8.57)
$WML_{i,t}$	-0.43***	-0.43***	-0.43***	-0.43***	-0.35***
	(-30.76)	(-30.93)	(-30.76)	(-30.93)	(-15.11)
Constant	0.00***	0.00	0.00	0.01***	-0.01**
	(4.68)	(0.39)	(1.79)	(8.18)	(-3.10)
Observations	23377	23377	23377	23377	9521
Adjusted R^2	0.283	0.284	0.283	0.285	0.244

This table contains the regression results for the return sensitivities of value and growth stocks to monthly changes in short-term interest rates (STIR). The dependent variable is the monthly total return in excess of the risk-free rate. The indicator variables value, middle, and growth are constructed according to the NAV spread at the end of the previous month. The interest rate sensitivities of value and growth stocks are measured by interacting the monthly changes in STIR with the respective indicator variable. Models (1)-(4) are estimated on the basis of the full sample, while model (5) is estimated by reducing the sample to value and growth stocks in order to directly test for a potential difference in the interest rate sensitivity between value and growth stocks. RM, SMB, HML, and WML represent the Carhart four-factor model control variables. The panel regression models are estimated using fixed effects. T-statistics are in parentheses. Coefficients marked with ***,** and * are significant at the 1%, 5% and 10% levels, respectively.

Table 4.4 contains the regression results for long-term interest rates (LTIR). The related Hypothesis 4.2 states that the risk-adjusted returns of growth stocks are more sensitive to LTIR changes than the returns of value stocks. The first column of Table 4.4 shows that real estate stocks in general are sensitive to changes in the LTIR. In contrast to the results in Table 4.3, this confirms the economic intuition of a negative reaction of stock prices following interest rate increases. The coefficient on the value interaction term in model 2 is positive but not significant. In contrast, model 4 reveals that the growth stocks are even more sensitive to LTIR changes and the effect is statistically significant. This suggests that growth stocks tend to fall even more than value stocks when the LTIR increases. The results in model 5 show that the interaction term between value and ΔLTIR is positive (2.65) and significant at the 5% level. That is, for a 100-basis point increase in ΔLTIR, the average decrease in returns on value stocks would be 265 basis points lower on average than the return on growth stocks. The Table 4.4 results are consistent with the idea that the impact of a rising discount rate is more pronounced for growth stocks, whose cash flows tend to be leaned towards the future in contrast to those of value stocks (Hypothesis 4.2).

Table 4.4: Long-term Interest Rate Sensitivity of Value and Growth Stocks.

	(1)	**(2)**	**(3)**	**(4)**	**(5)**
$\Delta LTIR_{i,t}$	-2.54***	-2.73***	-3.07***	-2.03***	-4.14***
	(-9.05)	(-8.93)	(-6.93)	(-6.49)	(-6.66)
$\Delta LTIR_{i,t} * D\_Value_{i,t}$	-	1.29	-	-	2.65**
	-	(1.77)	-	-	(2.86)
$\Delta LTIR_{i,t} * D\_Mid_{i,t}$	-	-	0.86	-	-
	-	-	(1.54)	-	-
$\Delta LTIR_{i,t} * D\_Growth_{i,t}$	-	-	-	-2.34***	-
	-	-	-	(-3.53)	-
$D\_Value(P1)_{i,t}$	-	0.01***	-	-	0.02***
	-	(6.44)	-	-	(4.98)
$D\_Mid(P2)_{i,t}$	-	-	0.00	-	-
	-	-	(0.95)	-	-
$D\_Growth(P3)_{i,t}$	-	-	-	-0.02***	-
	-	-	-	(-7.86)	-
$RM_{i,t}$	1.03***	1.03***	1.03***	1.03***	1.01***
	(83.48)	(83.43)	(83.46)	(83.49)	(53.79)
$SMB_{i,t}$	-0.03	-0.03	-0.03	-0.03	-0.05
	(-1.27)	(-1.29)	(-1.31)	(-1.38)	(-1.62)
$HML_{i,t}$	0.32***	0.32***	0.33***	0.32***	0.30***
	(14.63)	(14.48)	(14.68)	(14.63)	(8.35)
$WML_{i,t}$	-0.44***	-0.44***	-0.44***	-0.44***	-0.36***
	(-31.50)	(-31.60)	(-31.51)	(-31.65)	(-15.65)
Constant	0.00***	-0.00	0.00	0.01***	-0.01***
	(3.90)	(-0.33)	(1.27)	(7.68)	(-3.37)
Observations	23377	23377	23377	23377	9521
Adjusted R2	0.285	0.287	0.285	0.287	0.248

This table contains the regression results for the return sensitivities of value and growth stocks to monthly changes in long-term interest rates (LTIR). The dependent variable is the monthly total return in excess of the risk-free rate. The indicator variables value, middle, and growth are constructed according to the NAV spread at the end of the previous month. The interest rate sensitivities of value and growth stocks are measured by interacting the monthly changes in STIR with the respective indicator variable. Models (1)-(4) are estimated on the basis of the full sample, while model (5) is estimated by reducing the sample to value and growth stocks in order to directly test for a potential difference in the interest rate sensitivity between value and growth stocks. RM, SMB, HML, and WML represent the Carhart four-factor model control variables. The panel regression models are estimated using fixed effects. T-statistics are in parentheses. Coefficients marked with ***,** and * are significant at the 1%, 5% and 10% levels, respectively.

Table 4.5 reports the regression results for changes in the term spread (TERM). Overall, the results are similar to the Table 4.4 results. A rising term spread negatively impacts all real estate stocks in general (model 1). Value stocks are however less strongly affected, as evidenced by the positive and significant coefficient on the interaction term in model 2. This result is in consistent with Hahn and Lee (2006), who report a (positive) loading for value stocks from changes in the term spread. In contrast, growth stocks are more than proportionally affected by a rising term spread (model 4). Model 5 shows that the coefficient on the interaction term between value and ΔTERM is positive and significant at the 1% level. For a 100-basis point increase in the term spread, the decrease in return on value stocks is 304 basis points lower on average than the return on growth stocks. In summary, the results in Table 4.4 and Table 4.5 are consistent with Hypothesis 4.2.

Table 4.5: Term Spread (TERM) Sensitivity of Value and Growth Stocks.

	(1)	**(2)**	**(3)**	**(4)**	**(5)**
$\Delta TERM_{i,t}$	-1.53***	-1.89***	-1.75***	-1.03***	-3.04***
	(-7.55)	(-8.52)	(-5.45)	(-4.59)	(-6.69)
$\Delta TERM_{i,t} * D\_Value_{i,t}$	-	2.13***	-	-	3.04***
	-	(4.10)	-	-	(4.55)
$\Delta TERM_{i,t} * D\_Mid_{i,t}$	-	-	0.35	-	-
	-	-	(0.87)	-	-
$\Delta TERM_{i,t} * D\_Growth_{i,t}$	-	-	-	-2.43***	-
	-	-	-	(-5.01)	-
$D\_Value(P1)_{i,t}$	-	0.01***	-	-	0.02***
	-	(6.46)	-	-	(5.12)
$D\_Mid(P2)_{i,t}$	-	-	0.00	-	-
	-	-	(0.92)	-	-
$D\_Growth(P3)_{i,t}$	-	-	-	-0.02***	-
	-	-	-	(-7.83)	-
$RM_{i,t}$	1.02***	1.02***	1.02***	1.02***	1.00***
	(83.62)	(83.55)	(83.63)	(83.74)	(53.57)
$SMB_{i,t}$	-0.03	-0.03	-0.03	-0.03	-0.05
	(-1.40)	(-1.42)	(-1.41)	(-1.48)	(-1.59)
$HML_{i,t}$	0.35***	0.34***	0.35***	0.35***	0.32***
	(15.76)	(15.55)	(15.79)	(15.75)	(8.92)
$WML_{i,t}$	-0.44***	-0.45***	-0.44***	-0.45***	-0.37***
	(-31.57)	(-31.72)	(-31.56)	(-31.73)	(-15.66)
Constant	0.00***	0.00	0.00	0.01***	-0.01***
	(4.63)	(0.29)	(1.67)	(8.23)	(-3.30)
Observations	23377	23377	23377	23377	9521
Adjusted R2	0.284	0.286	0.284	0.287	0.247

This table contains the regression results for the return sensitivities of value and growth stocks to monthly changes in the term spread (TERM). The dependent variable is the monthly total return in excess of the risk-free rate. The indicator variables value, middle, and growth are constructed according to the NAV spread at the end of the previous month. The interest rate sensitivities of value and growth stocks are measured by interacting the monthly changes in STIR with the respective indicator variable. Models (1)-(4) are estimated on the basis of the full sample, while model (5) is estimated by reducing the sample to value and growth stocks in order to directly test for a potential difference in the interest rate sensitivity between value and growth stocks. RM, SMB, HML, and WML represent the Carhart four-factor model control variables. The panel regression models are estimated using fixed effects. T-statistics are in parentheses. Coefficients marked with ***,** and * are significant at the 1%, 5% and 10% levels, respectively.

Table 4.6 contains the regression results for the corporate bond yield (CBY). The negative and significant coefficient on ΔCBY in model 1 reveals that real estate stocks are negatively affected by an increase in corporate bond yields. This effect is even more pronounced for value stocks (model 2). A comparison of the marginal interest rate sensitivities in models 2 and 4 suggests that value stocks suffer more than growth stocks when corporate bond yields increase. This result is supported by model 5. The interaction term of value and ΔCBY in model 6 reveals that the difference in return sensitivities between value and growth is -1.59, which is significant at the 1% level. That is, for a 100-basis point increase in the CBY, the decrease in return on value stocks would be -159 basis points higher on average than the return on growth stocks (ceteris paribus).

Table 4.6: Corporate Bond Yield (CBY) Sensitivity of Value and Growth Stocks.

	(1)	(2)	(3)	(4)	(5)
$\Delta CBY_{i,t}$	-1.32***	-1.11***	-1.11***	-1.64***	-0.53**
	(-15.25)	(-11.63)	(-9.38)	(-16.56)	(-3.20)
$\Delta CBY_{i,t} * D\_Value_{i,t}$	-	-0.93***	-	-	-1.59***
	-	(-4.78)	-	-	(-6.70)
$\Delta CBY_{i,t} * D\_Mid_{i,t}$	-	-	-0.43**	-	-
	-	-	(-2.70)	-	-
$\Delta CBY_{i,t} * D\_Growth_{i,t}$	-	-	-	1.19***	-
	-	-	-	(6.60)	-
$D\_Value(P1)_{i,t}$	-	0.01***	-	-	0.02***
	-	(6.13)	-	-	(4.88)
$D\_Mid(P2)_{i,t}$	-	-	0.00	-	-
	-	-	(0.92)	-	-
$D\_Growth(P3)_{i,t}$	-	-	-	-0.02***	-
	-	-	-	(-7.63)	-
$RM_{i,t}$	0.95***	0.95***	0.95***	0.95***	0.93***
	(74.36)	(74.37)	(74.37)	(74.45)	(47.15)
$SMB_{i,t}$	-0.05*	-0.05**	-0.05*	-0.05*	-0.08*
	(-2.43)	(-2.61)	(-2.36)	(-2.43)	(-2.37)
$HML_{i,t}$	0.39***	0.39***	0.39***	0.39***	0.34***
	(17.49)	(17.35)	(17.51)	(17.50)	(9.66)
$WML_{i,t}$	-0.40***	-0.41***	-0.40***	-0.40***	-0.32***
	(-28.98)	(-29.15)	(-28.91)	(-29.02)	(-13.86)
Constant	0.00***	0.00	0.00	0.01***	-0.01**
	(4.52)	(0.30)	(1.62)	(8.03)	(-3.13)
Observations	23377	23377	23377	23377	9521
Adjusted R2	0.290	0.292	0.290	0.293	0.255

This table contains the regression results for the return sensitivities of value and growth stocks to monthly changes in corporate bond yields (CBY). The dependent variable is the monthly total return in excess of the risk-free rate. The indicator variables value, middle, and growth are constructed according to the NAV spread at the end of the previous month. The interest rate sensitivities of value and growth stocks are measured by interacting the monthly changes in STIR with the respective indicator variable. Models (1)-(4) are estimated on the basis of the full sample, while model (5) is estimated by reducing the sample to value and growth stocks in order to directly test for a potential difference in the interest rate sensitivity between value and growth stocks. RM, SMB, HML, and WML represent the Carhart four-factor model control variables. The panel regression models are estimated using fixed effects. T-statistics are in parentheses. Coefficients marked with ***,** and * are significant at the 1%, 5% and 10% levels, respectively.

Table 4.7 contains the results for the default spread (DEF), which are similar to those for CBY. However, the results of the model 6 regressions reveal that the return difference for changes in ΔDEF is slightly larger (-1.66) than that for ΔCBY and is also significant at the 1% level.

Table 4.7: Default Spread (DEF) Sensitivity of Value and Growth Stocks.

	(1)	(2)	(3)	(4)	(5)
$\Delta DEF_{i,t}$	-1.07***	-0.85***	-0.87***	-1.41***	-0.25
	(-12.38)	(-8.92)	(-7.55)	(-14.29)	(-1.56)
$\Delta DEF_{i,t} * D\_Value_{i,t}$	-	-1.00***	-	-	-1.66***
	-	(-5.31)	-	-	(-7.20)
$\Delta DEF_{i,t} * D\_Mid_{i,t}$	-	-	-0.40**	-	-
	-	-	(-2.60)	-	-
$\Delta DEF_{i,t} * D\_Growth_{i,t}$	-	-	-	1.23***	-
	-	-	-	(7.08)	-
$D\_Value(P1)_{i,t}$	-	0.01***	-	-	0.02***
	-	(6.32)	-	-	(5.04)
$D\_Mid(P2)_{i,t}$	-	-	0.00	-	-
	-	-	(0.92)	-	-
$D\_Growth(P3)_{i,t}$	-	-	-	-0.02***	-
	-	-	-	(-7.74)	-
$RM_{i,t}$	0.95***	0.95***	0.95***	0.95***	0.93***
	(72.86)	(72.94)	(72.81)	(72.89)	(46.76)
$SMB_{i,t}$	-0.06**	-0.06**	-0.06**	-0.06**	-0.08*
	(-2.94)	(-3.07)	(-2.91)	(-2.98)	(-2.49)
$HML_{i,t}$	0.39***	0.38***	0.39***	0.39***	0.34***
	(17.30)	(17.10)	(17.36)	(17.35)	(9.41)
$WML_{i,t}$	-0.40***	-0.41***	-0.40***	-0.40***	-0.32***
	(-28.83)	(-29.01)	(-28.75)	(-28.83)	(-13.77)
Constant	0.00***	0.00	0.00	0.01***	-0.01**
	(4.83)	(0.45)	(1.80)	(8.37)	(-3.15)
Observations	23377	23377	23377	23377	9521
Adjusted R2	0.287	0.289	0.288	0.291	0.253

This table contains the regression results for the return sensitivities of value and growth stocks to monthly changes in the default spread (DEF). The dependent variable is the monthly total return in excess of the risk-free rate. The indicator variables value, middle, and growth are constructed according to the NAV spread at the end of the previous month. The interest rate sensitivities of value and growth stocks are measured by interacting the monthly changes in STIR with the respective indicator variable. Models (1)-(4) are estimated on the basis of the full sample, while model (5) is estimated by reducing the sample to value and growth stocks in order to directly test for a potential difference in the interest rate sensitivity between value and growth stocks. RM, SMB, HML, and WML represent the Carhart four-factor model control variables. The panel regression models are estimated using fixed effects. T-statistics are in parentheses. Coefficients marked with ***,** and * are significant at the 1%, 5% and 10% levels, respectively.

The results in Table 4.6 and Table 4.7 confirm our Hypothesis 4.3 – value stocks are more sensitive to deteriorating capital market conditions. This hypothesis is supported further by the descriptive statistics shown in Table 4.1, which reveal that the return of value stocks is notably higher than the average return of growth stocks, indicating a value premium. The standard deviation reveals that value stocks are also riskier than growth stocks, which is in line with previous research (e.g., Rosenberg et al., 1985). Thus, we assume that opportunistic capital rotates out of value stocks in the case of rising corporate bond yields into now more attractive opportunistic investment opportunities such as corporate bonds.

A potential limitation of our study is that our hypotheses are based on three channels, while our empirical study can only measure a direct impact on the capital market channel. Thus, data limitations lead to a lack of evidence regarding how the two other channels (corporate channel and property channel) are directly impacted by interest rate changes. Furthermore, there may be cross-country differences regarding the application of particular accounting principles, asset valuation methods, or the regional or property type focus of the real estate stocks in our sample.

4.5 Conclusion

This study examines the diverging interest rate sensitivities of value and growth stocks. Using a global sample of listed real estate companies and five interest rate proxies, we provide new insights into the relationship between interest rate changes and the returns of stocks with fundamentally different characteristics.

Our major findings can be summarized as follows. First, value stocks are more sensitive to changes in short-term interest rates. Due to their low ratio of price-to-fundamental value, value stocks promise higher initial yields than growth stocks. When short-term interest rates rise, income-oriented investors tend to rotate out of risky assets into the higher-yielding risk-free rate. Second, growth stocks are more sensitive to changes in the long-term interest rate. This is consistent with a relatively stronger impact of a higher discount rate on the present value of the future cash flows of growth stocks compared to value stocks. In contrast, the more front-loaded cash flows of value stocks are less strongly affected by higher discount rates. Third, value stocks are more sensitive to changes in the corporate bond yield. Credit costs have a direct impact on a firm’s cost of capital. In theory, value stocks tend to be associated with higher credit risk margins. Consequently, they are also disproportionately affected by higher bond rates than growth stocks.

Our results have important implications for fund managers, risk officers, and private and institutional investors regarding how to hedge against changes in the five interest rate proxies. Furthermore, our paper contributes to the body of academic knowledge, as our results lend support to the "macroeconomic risk story," which states that the value premium anomaly is related to value stocks having higher interest rate risk than growth stocks (Lioui and Maio, 2014).

Chapter 5
Conclusion

This dissertation provides comprehensive empirical evidence on a global panel of real estate value and growth stocks from the most significant real estate operating companies (REOCs) and real estate investment trusts (REITs) in the world. The panel is based on the FTSE EPRA/NAREIT Global Real Estate Index series, which ensures sufficient quality requirements with regard to liquidity, free-float, and income from underlying real estate activities. My basic concept here is to categorize listed real estate stocks according to the deviations of their stock prices from their underlying net asset values. In this vein, the stocks are designated as either real estate value or growth stock. I observe long-lasting and partially excessive NAV spreads that shape different patterns in individual countries (see chapter 2). However, these deviations do not appear to be rationally justified, since the NAV is assumed to be a reliable indicator of the underlying fundamental value of listed real estate. I follow the real estate literature and term this phenomenon the *"NAV spread puzzle."* This dissertation makes the following major empirical findings and contributions.

First, this dissertation identifies and empirically confirms the factors that help explain the NAV spread puzzle. There are two main groups: idiosyncratic factors, which include company size, leverage ratio, interest coverage ratio, and risk as represented by the CAPM beta factor, and systematic factors, which include credit market indicators such as the default and term spreads that are widely used to indicate expectations about the credit market and monetary policy conditions. Furthermore, real estate as well as general stock market sentiment seems to contribute to explaining NAV spreads.

Second, this dissertation empirically proves that these deviations can be exploited by investors to achieve a value premium over growth stocks. With the paper in chapter 2, my co-authors and I show that real estate value stocks strongly outperform growth stocks in most of the countries in our sample. However, this comes with greater risk. We find that the value premium can be captured on a risk-adjusted basis when investors follow a global investment strategy, and when they base their strategy on relative rather than absolute mispricing.

Third, this dissertation proves the importance of interest rates for the performance of listed real estate. It is shown that different interest rate proxies are important drivers for the total return of a listed real estate exposure. Moreover, value and growth investors must be aware that they are *disproportionately* prone to changes in *different* interest rate proxies. E.g., value stocks are more sensitive to changes in short-term interest rates than what would be explained by their low ratio of price-to-fundamental value. Value stocks promise higher initial yields than growth stocks. When short-term interest rates rise, income-oriented investors tend to rotate out of risky assets into the higher-yielding risk-free rate.

The joint contribution of the three studies presented in this dissertation is to shed new light on the key questions regarding value and growth stocks posed in the introduction: *1) "Do value stocks outperform growth stocks in the long run?"* and *2) "Which factors lead to the deviations in stock prices and fundamental values?"* My results have important implications for researchers, fund managers, risk managers, and private and institutional investors, as well as legislators. Interesting avenues for future research could be to provide deeper insights into the performance attributes of the underlying *company channel* and *property channel*, and thereby amending the research on the *capital market channel*. The role of sentiment and additional macroeconomic factors is also a fertile area for study. Examining the role of interest rates on the direct property market and the timing nature of real estate appraisal could be additionally instructive for future research.

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