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Which Stocks are Driven by Which Interest Rates?

Evidence from Listed Real Estate

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Abstract

This paper analyzes the return sensitivities of real estate value and growth stocks to changes in five different interest rate proxies. Using a global sample of 352 listed real estate companies from *12 countries as a test object, we find that real estate value stocks are more sensitive than real estate growth stocks to changes in the short-term interest rate. This finding 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, real estate 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 real estate 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.*

Key Words: Interest Rate Sensitivity, Value vs. Growth, Net Asset Value

1 Introduction

In recent years, there has been an increasing interest in the diverging characteristics of value vs. growth investments in real estate (see for example Ooi et al, 2007, Addae-Dapaah et al, 2013, Beracha et al, 2017, and Woltering et al, 2018). Value stocks are defined by a low ratio of price to fundamental value, such as earnings, cash flows, or book assets. As a result, they tend to have higher initial yields. In contrast, growth stocks tend to trade at high valuations and lower current yields. This is typically explained by a positive outlook regarding the growth potential of future cash flows. On average, however, value stocks tend to produce higher risk adjusted returns than growth stocks (see for example Woltering et al, 2018). The so-called value premium has led to an intense debate in the general finance literature regarding whether financial markets are efficient. On the one hand, value stocks are linked to a higher risk of financial distress (Fama and French, 1995). On the other hand, expectations tend to be irrational as investors tend to place too much emphasis on the extrapolation of recent trends (Lakonishok et al, 1994).

It is also well documented that stock returns are affected by interest rate changes. Lioui and Maio (2014) establish a link between the interest rate literature and the value vs. growth debate. The authors document that value stocks have higher interest rate risk than growth stocks and conclude that interest rate risk is a key factor in explaining the value premium. However, as documented in the real estate literature, stock returns are not only known to be affected by short-term rates. Chen and Tzang (1988), Allen et al. (2000), and Akimov et al. (2015) find that real estate stocks are also sensitive to changes in long-term interest rates. Moreover, 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. This raises the question of whether value and growth stocks may not only be disproportionately affected by short-term rates, but also by long-term rates, corporate bonds yields, or other interest rate proxies?

In this paper we examine the interest rate sensitivity of real estate stocks. The listed real estate sector has historically provided strong returns compared to other segments of the stock market. As a result, there are numerous real estate-focused exchanged traded funds (ETFs) as well as actively managed mutual funds. In addition, many asset allocation models suggest real estate should play a significant role in diversified multi asset class portfolios. Thus, non-specialized investors, too, may seek to diversify part of their funds into listed real estate. In the current low interest rate environment, REITs may be appeal to investors due to the high dividend yields offered.

In particular, we systematically assess 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. 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). Listed real estate companies are particularly well-suited to studying the impact of interest rate changes. The focus on one stock market sector reduces the impact of sector-specific trends that may have a confounding impact on returns. More importantly, there are three obvious channels through which interest rates may impact the stock market returns of listed real estate companies: 1) the relative attractiveness of equities 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 debt costs, and 3) 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).

Our empirical analysis is based on a global panel of 352 listed REITs and REOCs in 12 countries over the 2005-2014 period. This global setting offers a strong degree of heterogeneity in interest rates and NAV-spreads. Existing research differentiates value and growth stocks usually according to their book-to-market ratios of equity. We follow the approach of Woltering et al. (2018) and 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. IFRS accounting requires reporting assets at their fair value. 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 to study potential discrepancies between the interest rate sensitivities of value and growth stocks.

We use panel regressions at the individual stock level to examine the diverging interest rate sensitivities of real estate value and growth stocks. Using a 4-factor model that controls for common risk factors (Carhart, 1997), 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. Value (growth) stocks are those who belong to the quintile of stocks with the highest (lowest) discount to NAV.

We provide two major contributions to the value vs. growth debate. 1) We document that real estate growth stocks are more sensitive to changes in the long-term interest rate. The expected future cash flows of growth stocks are more leaned towards the future compared to value stocks. 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. Hence, our finding is consistent with changes of LTIRs having a stronger impact on the present values of real estate growth stocks as compared to real estate value stocks. 2) We find that real estate value stocks are more sensitive to changes in the credit yield. Credit costs have a direct impact on a firm's cost of capital. As value stocks tend to be more highly leveraged than growth stocks, increasing corporate bond yields have a relatively stronger impact on the returns of value stocks as opposed to growth stocks. This finding lends support to risk-based theories of the value premium, according to which value stocks are riskier because they tend to have higher leverage and a greater default probability.

In addition, we contribute to the real estate literature by documenting that real estate value stocks, too, are more sensitive than real estate growth stocks to changes in the short-term interest rate. We relate this finding to the theory that investors with shorter investment horizons trade off the high initial yield of value stocks against lower-risk short-term interest rates.

The remainder of this paper is organized as follows. Section 2 contains the related literature and provides our hypotheses. Section 3 explains the data set and the methodological approach. Section 4 contains the empirical results. Section 5 concludes.

2 Related Literature and Hypotheses

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.

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.

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 real estate 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 1: *The risk-adjusted returns of real estate value stocks are more sensitive to changes in short-term interest rates than those of real estate growth stocks.*

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 real estate 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 real estate growth stocks as compared to real estate value stocks. We formulate our second hypothesis accordingly:

Hypothesis 2: *The risk-adjusted returns of real estate growth stocks are more sensitive to changes in long-term interest rates than those of real estate value stocks.*

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

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 3: *The risk-adjusted returns of real estate value stocks are more sensitive to changes in corporate bond yields than those of real estate 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 real estate growth stocks to changes in the default spread.

3 Data and Methodology

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,[4] and 4) publication of audited annual accounting reports in English.[5]

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).

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.

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

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

3.3 Classification of real estate value and growth stocks

In order to group the sample into real estate 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”:

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

The major shortcoming of sorting real estate 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*:

$$Relative\ NAV\ spread_{i,j,t} = NAV\ spread_{i,j,t} - \ Average\ Country\ NAV\ spread_{j,t} \quad (2)$$

Real estate 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.

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:

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

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

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.

3.5 Methodology: Modeling the Interest Rate Sensitivities of real estate 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:

$$R_{i,t} - RF_t = \alpha + \beta_1 \Delta IR_t + \beta_2 (RM_t - RF_t) + \beta_3 SMB_t + \beta_4 HML_t + \beta_5 WML_t + \beta_6 (Value_{i,t} * \Delta IR_t) + \beta_7 (Mid_{i,t} * \Delta IR_t) + \beta_8 (Growth_{i,t} * \Delta IR_t) + \beta_9 Value_{i,t} + \beta_{10} Mid_{i,t} + \beta_{11} Growth_{i,t} \quad (5)$$

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.[6] 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 market wide 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 1-3, we also directly control for differences between the interest rate sensitivities of real estate value and growth stocks by reducing the entire sample to value and growth stocks and then establishing the following panel regression model:

$$R_{i,t} - RF_t = \alpha + \beta_1 \Delta IR_t + \beta_2 (RM_t - RF_t) + \beta_3 SMB_t + \beta_4 HML_t + \beta_5 WML_t + \beta_6 \left(Value_{i,t} * \Delta IR_{j,t} \right) + \beta_7 Value_{i,t} \quad (6)$$

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 (6) indicate whether real estate 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. Moreover, we use Newey-West standard errors, which are robust to both serial correlation and heteroscedasticity.[7]

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

[7] The Pesaran (2015) test for cross-sectional dependence reveals that each regression is robust in regards to (weak) cross-sectional dependence. To test for heteroscedasticity, we perform a modified Wald Test, which indicates the presence of groupwise heteroscedasticity in most regressions. Moreover, we test for serial correlation using the Wooldridge (2002) test for serial correlation. The results indicate serial correlation in some of the regressions.

3.6 Summary Statistics

Table 1 contains the summary statistics of key variables such as returns and NAV spreads for our global sample over the 2005-2014 period. The second column shows the summary statistics for the full sample (all stocks). Column 3 shows the summary statistics for the tercile of value stocks. Column 4 shows the summary statistics for tercile of stocks which neither belong to the value, nor the growth classification. Column 5 shows the summary statistics for the tercile of real estate growth stocks.

Panel A reveals that, consistent with the literature on the real estate value premium, the average monthly return of value stocks (1.48%) is notably higher than that of growth stocks (0.49%). However, 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 descriptive statistics in Panel B show that the share price of real estate value stocks in our sample on average trades around the NAV (average NAVS=-1%), whereas the real estate growth stocks on average trade at a premium to NAV of 98%. This substantial difference is hardly justifiable without the implicit expectation of stock market participants that real estate growth stocks have substantially better growth prospects. These results also suggest that the value vs. growth separation within the real estate sector is valid.

The summary statistics for the five interest rate proxies (Panels C-H) 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 2 contains the contemporaneous correlation coefficients of returns, relative NAV spreads, and the five interest rate proxies.

4 Regression Results

Tables 3-7 contain the regression results for our five interest rate proxies (STIR, LTIR, CBY, DEF, and TERM) that are used to test Hypotheses 1-3. To ensure comparability across the obtained regression results, all 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.[8]

Table 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 insignificant in all models. Model 2 examines the impact of changes in the STIR on value real estate stocks. The coefficient on the value indicator variable is positive and statistically significant, which is consistent with the positive abnormal returns of real estate value stocks documented in the literature. Our focus is however on the marginal impact of short-term interest rates on real estate value stocks. The coefficient on the value interaction term is negative, but the effect is not statistically different from zero (t-statistic -1.45) when compared to all other stocks.

In contrast, the regression result in model 5 is based on a reduced sample that consists only of real estate 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. Here, the coefficient on the interaction term between value and STIR is -2.94. The effect is not only statistically, but also economically significant. For a 100-basis point increase in the STIR, the returns of real estate value stocks on average fall by 294 basis points more than real estate growth stocks. This finding 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.

[8] Following the suggestion of an anonymous referee, we include all three interest rates simultaneously and obtain results that are qualitatively in line with our main results. Moreover, as an additional robustness test, we examine the impact of our interest rate proxies on the sample of growth stocks and value stocks individually. The results are again qualitatively robust, with the exception of the impact of short-term rates which is negative (positive) but insignificant for value (growth) stocks. To provide conclusive empirical evidence on Hypothesis 1, however, a regression based on the combined sample is needed, which we provide in Table 3, column 5. The robustness tests are available from the authors upon request.

Model 3 shows the regression results for the middle portfolio. As expected, we find no significant differences. The middle portfolio is neither associated with significant abnormal returns nor a different sensitivity to short-term interest rates. We still choose to report these results for completeness and consistency.

In contrast, the model 4 results show that the coefficient on the interaction term between real estate growth stocks and interest rate changes in model 4 is positive and significant. This suggests that real estate 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.

In summary, the results in Table 3 are consistent with Hypothesis 1, the risk-adjusted returns of real estate value stocks are more sensitive than real estate growth stocks to changes in STIRs. A potential explanation for the stronger impact of an increase of the STIR on real estate 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.

The coefficient on the market return (RM) is close to one in all model specifications, suggesting that the real estate stocks in our sample, on average, move in line with the market. On the other hand, real estate stocks tend to load negatively on the small stock risk factor, as indicated by the negative and significant coefficient on SMB in all specifications. The coefficient on the HML factor is positive and significant in all specifications. Accordingly, the real estate stocks in our sample tend to load positively on the value risk factor, which is consistent with the perception of real estate stocks falling into the value, rather than the growth segment of the market. The coefficient on the WML factor is negative and significant in all models, hinting at a rather anti-cyclical stock market performance of real estate. While statistically significant, the coefficient on the constant of the regression model is close to zero in all specifications, suggesting that real estate stocks, on average, did not produce economically significant excess returns relative to the market.

For the other interest rate proxies in Tables 4-7, we obtain similar results for the mid portfolio (model 3 in each table), as well as the coefficients on the value and growth dummies, and the control variables. Accordingly, the following discussion focuses on our hypotheses, i.e. on the interpretation of the interest rate variables for the value vs. growth portfolios.

Table 4 contains the regression results for long-term interest rates (LTIR). The related Hypothesis 2 states that the risk-adjusted returns of real estate growth stocks are more sensitive to LTIR changes than the returns of real estate value stocks. The first column of Table 4 shows that real estate stocks in general are sensitive to changes in the LTIR. In contrast to the results in Table 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 real estate growth stocks are even more sensitive to LTIR changes and the effect is statistically significant. This suggests that real estate growth stocks tend to fall even more than real estate value stocks when the LTIR increases. The results in model 5 show that the interaction term between value and ΔLTIR is positive (2.72) and significant at the 5% level. That is, for a 100-basis point increase in ΔLTIR, the average decrease in returns on real estate value stocks would be 272 basis points less pronounced than for real estate growth stocks. The Table 4 results are consistent with the idea that the impact of a rising discount rate is more pronounced for real estate growth stocks, whose cash flows tend to be leaned towards the future in contrast to those of real estate value stocks (hypothesis 2).[9] The coefficients on the control variables are in line with those in Table 3. While the coefficient on the SMB factor remains negative, it is no longer statistically significant in the Table 4 specifications.

Table 5 reports the regression results for changes in the term spread (TERM). Overall, the results are similar to the Table 4 results. A rising term spread negatively impacts all real estate stocks in general (model 1). Real estate 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 consistent with Hahn and Lee

[9] When running a regression just on the sample of value stocks, the coefficient on LTIR is -2.60 (t-statistic -2.78), and the coefficient on growth stocks is -3.39 (t-statistic -5.41). While these results are consistent with H2, the regression results in Table 4, model (5) provide more direct empirical evidence for H2. These results are available from the authors upon request.

(2006), who report a (positive) loading for real estate value stocks from changes in the term spread. In contrast, real estate 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 real estate value stocks is 341 basis points lower on average than the return on real estate growth stocks. In summary, the results in Tables 4 and 5 are consistent with Hypothesis 2. The coefficients on the control variables are in line with those in Table 4.

Table 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 real estate value stocks (model 2). A comparison of the marginal interest rate sensitivities in models 2 and 4 suggests that real estate value stocks suffer more than real estate 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 -1.67, which is significant at the 1% level. That is, for a 100-basis point increase in the CBY, the decrease in return on real estate value stocks would be -167 basis points higher on average than the return on real estate growth stocks (ceteris paribus). Table 7 contains the results for the default spread (DEF), which are similar to those for CBY. However, the results of the model 5 regressions reveal that the return difference for changes in ΔDEF is slightly larger (-1.74) than that for ΔCBY and is also significant at the 1% level. The coefficients on the control variables in Tables 6 and 7 are in line with those in Table 3.

The results in Tables 6 and 7 confirm our Hypothesis 3 – real estate value stocks are more sensitive to deteriorating capital market conditions. This finding may also be explained by a "flight-to-quality", where investors sell what they perceive higher risk assets such as overleveraged real estate value stocks. This hypothesis is supported further by the descriptive statistics shown in Table 1, which reveal that the return of real estate value stocks is notably higher than the average return of real estate growth stocks, indicating a value premium. The standard deviation reveals that real estate value stocks are also riskier than real estate growth stocks, which is in line with previous research (e.g., Rosenberg et al., 1985).

Thus, we assume that opportunistic capital rotates out of real estate value stocks in the case of rising corporate bond yields into now more attractive opportunistic investment opportunities such as corporate bonds.

5 Conclusion

This study examines the diverging interest rate sensitivities of real estate 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, real estate 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, real estate 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 real estate value stocks are less strongly affected by higher discount rates. Third, real estate 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, real estate value stocks tend to be associated with higher credit risk margins. Consequently, they are also disproportionately affected by higher bond rates than growth stocks. In summary, the results in this paper contribute to our understanding of the impact of interest rates on asset pricing.

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).

Moreover, our results have practical implications for fund managers, risk officers, and private and institutional investors concerning portfolio allocations to real estate stocks in the presence of interest rate risk. First of all, our empirical findings will raise awareness for the different types of interest rate risk exposure in real estate stocks. For example, investment managers will be able to identify interest rate risk exposure in their portfolios depending on whether their portfolio is rather titled towards value or growth stocks. During times of high uncertainty when interest rates are likely to be volatile, but it is not clear in which direction they will move, managers may want to balance their portfolio across value and growth stocks to limit the volatility of portfolio returns. Secondly, in case investment managers have clear expectations about the future direction of interest rates, our findings have actionable implications. For example, our results suggest that the anticipation of falling short-term rates would favor value stocks, whereas rising long-term rates would favor growth stocks.

Hedging certain parts of the portfolio via interest rate swaps may be an attractive option, if an investment manager is concerned about interest rate risk in the short term. In fact, such a hedge may be the more economical solution in case an investment manager is unwilling to fundamentally alter the portfolio, but concerned about interest rate changes in the short term. As long as positions are only hedged for a few months, the risk neutralization may well outweigh the cost of hedging. Moreover, in the short term, stocks are also unlikely to move from value to growth, which could require a different hedging approach. Over the long term, however, hedging via interest rate swaps may be too expensive and a fundamental repositioning of the portfolio may be more advisable.

We note that some REIT investors may be primarily interested in taking exposure to the underlying assets, rather than “playing” interest rate changes. On the other hand, and irrespective of the underlying assets, it plays a major role for the returns obtained by investors for which stock market price they can buy and sell the REITs. Our results document that interest rate changes do have a significant impact on stock prices, so investors can benefit from taking this relevant factor into account. Moreover, a relevant fraction of the stock market participants may be interested in entering opportunistic positions if they have a strong opinion on future interest rate changes. Those investors in turn would have an impact on a REIT’s share price, thus indirectly impacting also those REIT investors that are primarily interested in the exposure to the underlying assets.

We acknowledge that, as with any model, our model is necessarily an incomplete abstraction of reality in all its details. In practice, REIT investment decisions are driven by a number of factors, where interest rates are just one variable. For example, investors may not rush to invest into office REITs just because long term rates are falling, if the underlying office market is struggling – a market condition that tends to be associated with falling interest rates. Nevertheless, the focus of our study is on the marginal impact of interest rates on different segments of the REIT market, in particular value vs. growth stocks. Our model expands the interest rate literature in the context of REITs and can give practitioners insight into which REITs may be more or less attractive under varying interest rate regimes.

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Table 1: Summary Statistics

	Total	Value	Middle	Growth
Panel A: Total Returns				
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
Panel B: Absolute NAV Spreads				
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
Panel C: Relative NAV Spreads				
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
Panel D: Short Term Interest Rates				
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
Panel E: Long Term Interest Rates				
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
Panel F: Corporate Bond Yields				
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
Panel G: Default Spreads				
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

Table 1 continued

Panel H: Term Spreads				
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, absolute and 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. Panels A and B are based on monthly data, while Panels C to H are based on yearly data. The second column shows the summary statistics for the full sample (all stocks). Column 3 shows the summary statistics for the tercile of value stocks. Column 4 shows the summary statistics for tercile of stocks which neither belong to the value, nor the growth classification. Column 5 shows the summary statistics for the tercile of real estate growth stocks.

Table 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.

Table 3: Short-term Interest Rate Sensitivity of Value and Growth Stocks

	(1)	(2)	(3)	(4)	(5)
$\Delta STIR_{i,t}$	0.28	0.59	0.17	0.00	1.37*
	(0.66)	(1.30)	(0.24)	(0.01)	(1.92)
$\Delta STIR_{i,t} * D\_Value_{i,t}$	-	-2.07	-	-	-2.94*
		(-1.45)			(-1.93)
$\Delta STIR_{i,t} * D\_Mid_{i,t}$	-	-	0.18	-	-
			(0.19)		
$\Delta STIR_{i,t} * D\_Growth_{i,t}$	-	-	-	1.50*	-
				(1.70)	
$D\_Value_{i,t}$	-	0.00***	-	-	0.01***
		(2.62)			(3.83)
$D\_Mid_{i,t}$	-	-	0.00	-	-
			(0.58)		
$D\_Growth_{i,t}$	-	-	-	-0.01***	-
				(-4.43)	
$RM_{i,t}$	1.01***	1.01***	1.01***	1.01***	1.00***
	(57.40)	(57.51)	(57.48)	(57.31)	(37.70)
$SMB_{i,t}$	-0.05*	-0.06**	-0.05*	-0.05*	-0.07*
	(-1.93)	(-2.01)	(-1.93)	(-1.93)	(-1.87)
$HML_{i,t}$	0.34***	0.34***	0.34***	0.34***	0.32***
	(9.30)	(9.28)	(9.33)	(9.32)	(5.45)
$WML_{i,t}$	-0.43***	-0.43***	-0.43***	-0.43***	-0.37***
	(-11.88)	(-11.90)	(-11.88)	(-11.92)	(-5.91)
Constant	0.00***	0.00***	0.00**	0.00***	-0.00
	(4.74)	(3.27)	(2.55)	(6.00)	(-0.92)
Observations	23377	23377	23377	23377	9521
Adjusted R^2	0.28	0.28	0.28	0.28	0.24

This table contains the regression results for the return sensitivities of real estate 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 real estate 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 real estate 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 Newey-West robust standard errors. T-statistics are in parentheses. Coefficients marked with ***,** and * are significant at the 1%, 5% and 10% levels, respectively.

Table 4: Long-term Interest Rate Sensitivity of Value and Growth Stocks

	(1)	(2)	(3)	(4)	(5)
$\Delta LTIR_{i,t}$	-2.55***	-2.73***	-3.13***	-2.04***	-4.03***
	(-7.37)	(-7.12)	(-5.54)	(-4.92)	(-6.39)
$\Delta LTIR_{i,t} * D\_Value_{i,t}$	-	1.17	-	-	2.72**
		(1.02)			(2.25)
$\Delta LTIR_{i,t} * D\_Mid_{i,t}$	-	-	0.94	-	-
			(1.19)		
$\Delta LTIR_{i,t} * D\_Growth_{i,t}$	-	-	-	-2.40***	-
				(-3.11)	
$D\_Value(P1)_{i,t}$		0.00***	-	-	0.01***
		(2.70)			(4.04)
$D\_Mid(P2)_{i,t}$	-	-	0.00	-	-
			(0.69)		
$D\_Growth(P3)_{i,t}$	-	-	-	-0.01***	-
				(-4.75)	
$RM_{i,t}$	1.04***	1.04***	1.04***	1.04***	1.02***
	(56.89)	(56.91)	(56.85)	(56.85)	(37.91)
$SMB_{i,t}$	-0.03	-0.03	-0.03	-0.03	-0.05
	(-1.12)	(-1.14)	(-1.15)	(-1.15)	(-1.38)
$HML_{i,t}$	0.32***	0.32***	0.32***	0.32***	0.31***
	(8.52)	(8.49)	(8.55)	(8.54)	(5.20)
$WML_{i,t}$	-0.44***	-0.44***	-0.44***	-0.44***	-0.38***
	(-12.20)	(-12.21)	(-12.20)	(-12.25)	(-6.15)
Constant	0.00***	0.00**	0.00*	0.00***	-0.00
	(3.87)	(2.35)	(1.89)	(5.34)	(-1.60)
Observations	23377	23377	23377	23377	9521
Adjusted R^2	0.29	0.29	0.29	0.29	0.25

This table contains the regression results for the return sensitivities of real estate 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 real estate 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 real estate 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 Newey-West robust standard errors. T-statistics are in parentheses. Coefficients marked with ***,** and * are significant at the 1%, 5% and 10% levels, respectively.

Table 5: Term Spread (TERM) Sensitivity of Value and Growth Stocks

	(1)	(2)	(3)	(4)	(5)
$\Delta TERM_{i,t}$	-1.54***	-1.88***	-1.74***	-1.06***	-3.07***
	(-4.83)	(-5.51)	(-3.39)	(-2.82)	(-5.63)
$\Delta TERM_{i,t} * D\_Value_{i,t}$	-	2.04**	-	-	3.41***
		(2.00)			(3.12)
$\Delta TERM_{i,t} * D\_Mid_{i,t}$	-	-	0.33	-	-
			(0.48)		
$\Delta TERM_{i,t} * D\_Growth_{i,t}$	-	-	-	-2.33***	-
				(-3.57)	
$D\_Value(P1)_{i,t}$	-	0.00***	-	-	0.01***
		(2.64)			(3.95)
$D\_Mid(P2)_{i,t}$	-	-	0.00	-	-
			(0.67)		
$D\_Growth(P3)_{i,t}$	-	-	-	-0.01***	-
				(-4.56)	
$RM_{i,t}$	1.03***	1.02***	1.03***	1.03***	1.01***
	(57.16)	(57.23)	(57.27)	(57.15)	(38.02)
$SMB_{i,t}$	-0.03	-0.03	-0.03	-0.03	-0.05
	(-1.17)	(-1.19)	(-1.17)	(-1.19)	(-1.34)
$HML_{i,t}$	0.34***	0.34***	0.34***	0.34***	0.33***
	(9.40)	(9.35)	(9.43)	(9.42)	(5.64)
$WML_{i,t}$	-0.44***	-0.44***	-0.44***	-0.44***	-0.39***
	(-12.34)	(-12.36)	(-12.34)	(-12.41)	(-6.20)
Constant	0.00***	0.00***	0.00**	0.00***	-0.00
	(4.62)	(3.15)	(2.37)	(5.91)	(-1.15)
Observations	23377	23377	23377	23377	9521
Adjusted R^2	0.28	0.29	0.29	0.29	0.25

This table contains the regression results for the return sensitivities of real estate 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 real estate 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 real estate 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 Newey-West robust standard errors. T-statistics are in parentheses. Coefficients marked with ***,** and * are significant at the 1%, 5% and 10% levels, respectively.

Table 6: Corporate Bond Yield (CBY) Sensitivity of Value and Growth Stocks

	(1)	(2)	(3)	(4)	(5)
$\Delta CBY_{i,t}$	-1.33***	-1.13***	-1.11***	-1.65***	-0.49
	(-7.27)	(-5.58)	(-4.40)	(-7.89)	(-1.57)
$\Delta CBY_{i,t} * D\_Value_{i,t}$	-	-0.93**	-	-	-1.67***
		(-2.24)			(-3.55)
$\Delta CBY_{i,t} * D\_Mid_{i,t}$	-	-	-0.43	-	-
			(-1.24)		
$\Delta CBY_{i,t} * D\_Growth_{i,t}$	-	-	-	1.19***	-
				(3.21)	
$D\_Value(P1)_{i,t}$	-	0.00**	-	-	0.01***
		(2.46)			(3.68)
$D\_Mid(P2)_{i,t}$	-	-	0.00	-	-
			(0.61)		
$D\_Growth(P3)_{i,t}$	-	-	-	-0.01***	-
				(-4.39)	
$RM_{i,t}$	0.95***	0.95***	0.95***	0.95***	0.93***
	(52.59)	(52.54)	(52.69)	(52.67)	(34.22)
$SMB_{i,t}$	-0.05*	-0.06**	-0.05*	-0.05*	-0.07**
	(-1.96)	(-2.09)	(-1.89)	(-1.91)	(-2.03)
$HML_{i,t}$	0.38***	0.38***	0.38***	0.38***	0.36***
	(10.94)	(10.94)	(10.96)	(10.95)	(6.32)
$WML_{i,t}$	-0.40***	-0.41***	-0.40***	-0.40***	-0.34***
	(-11.00)	(-11.02)	(-10.98)	(-11.00)	(-5.31)
Constant	0.00***	0.00***	0.00**	0.00***	-0.00
	(4.49)	(3.04)	(2.37)	(5.72)	(-1.02)
Observations	23377	23377	23377	23377	9521
Adjusted R^2	0.29	0.29	0.29	0.29	0.26

This table contains the regression results for the return sensitivities of real estate 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 real estate 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 real estate 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 Newey-West robust standard errors. T-statistics are in parentheses. Coefficients marked with ***,** and * are significant at the 1%, 5% and 10% levels, respectively.

Table 7: Default Spread (DEF) Sensitivity of Value and Growth Stocks

	(1)	(2)	(3)	(4)	(5)
$\Delta DEF_{i,t}$	-1.08***	-0.86***	-0.88***	-1.41***	-0.22
	(-5.92)	(-4.27)	(-3.56)	(-6.85)	(-0.72)
$\Delta DEF_{i,t} * D\_Value_{i,t}$	-	-1.00**	-	-	-1.74***
		(-2.51)			(-3.86)
$\Delta DEF_{i,t} * D\_Mid_{i,t}$	-	-	-0.41	-	-
			(-1.21)		
$\Delta DEF_{i,t} * D\_Growth_{i,t}$	-	-	-	1.24***	-
				(3.45)	
$D\_Value(P1)_{i,t}$	-	0.00***	-	-	0.01***
		(2.64)			(3.90)
$D\_Mid(P2)_{i,t}$	-	-	0.00	-	-
			(0.61)		
$D\_Growth(P3)_{i,t}$	-	-	-	-0.01***	-
				(-4.57)	
$RM_{i,t}$	0.95***	0.95***	0.95***	0.95***	0.94***
	(50.39)	(50.34)	(50.39)	(50.46)	(33.53)
$SMB_{i,t}$	-0.06**	-0.07**	-0.06**	-0.06**	-0.08**
	(-2.35)	(-2.44)	(-2.31)	(-2.33)	(-2.14)
$HML_{i,t}$	0.38***	0.38***	0.38***	0.38***	0.35***
	(10.83)	(10.79)	(10.87)	(10.87)	(6.17)
$WML_{i,t}$	-0.40***	-0.41***	-0.40***	-0.40***	-0.34***
	(-11.03)	(-11.05)	(-11.01)	(-11.03)	(-5.31)
Constant	0.00***	0.00***	0.00**	0.00***	-0.00
	(4.82)	(3.26)	(2.57)	(6.10)	(-0.98)
Observations	23377	23377	23377	23377	9521
Adjusted R^2	0.29	0.29	0.29	0.29	0.25

This table contains the regression results for the return sensitivities of real estate 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 real estate 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 real estate 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 Newey-West robust standard errors. T-statistics are in parentheses. Coefficients marked with ***,** and * are significant at the 1%, 5% and 10% levels, respectively.