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Public REIT returns: the mechanism of leverage and diversification

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Abstract

The mechanism between leverage and geographical diversification has an essential role in identifying a negative diversification discount effect. High leverage levels increase firm-specific risk that can be diversified away, thereby lowering the risk premium in the form of lower excess returns. This paper investigates whether this mechanism applies to REIT excess returns by using a panel regression over three continental groups. Findings show a diversification discount in the form of a negative effect for the pooled- and European group on REIT excess returns. Further analysis shows that only specialized REITs incur this negative diversification discount effect on excess returns whereas this effect is no longer present when the REIT is diversified at any level. Furthermore, medium- to high leveraged REITs experience this negative diversification discount effect when geographically diversifying—illustrating that decreasing excess returns from a diversification discount effect is a function of a REIT's leverage level. These results imply that REITs with higher leverage levels can use geographical diversification to lower firm-specific risk, thereby, exposing investors to a lower risk.

Table of content

1. Introduction

With recent- and past markets shocks such as the financial crisis and the Covid-19 pandemic, different volatility levels in the stock market are present. In particular, the COVID-19 pandemic has brought significant volatility in international stock markets (Uddin et al., 2021). Based on the research by Newell & Peng (2009), the Great financial Crisis has had a major impact on the performance of Australian real estate investment trust (REIT). Australian REITs involved in high gearing, which involves having more debt compared to equity, underperformed significantly whereas low gearing REITs improved returns and lowered risk. Before the great financial crisis, Australian REITs used to focus on aggressive growth strategies to improve returns in the form of higher levels of debt (Newell & Peng, 2009).

For real estate funds, finding good properties for high returns is essential but complex because of increased competition for assets, deterring rent growth and a downturn fear in the real estate market (Putzier, 2019). These issues are a result of the idiosyncratic component of the local market fundamental drivers leading investors to look abroad for beta as well as more alpha exposure through regional, sector or asset picks. As the local real estate cycle could matures, geographical diversification becomes more attractive for European, U.S and Asian firms because investors use global diversification to diminish volatility, enhancing portfolio resilience and looking for possibilities to generate more alpha. In other words, higher returns that are generated from other idiosyncratic local markets (Synott et al., 2019).

Thus, geographical diversification enables a REIT to spread the idiosyncratic risk components from its business- and geographical segments. According to the CAPM, the risk premium only rewards investors for incurring market risk. The risk premium of a stock compensates the investor for the additional risk taken in additional returns (Berk & Demarzo, 2016). Geographical diversification affects some of the variation in market risk (Gyourko & Nelling, 1996). Although, there is evidence that specialized REITs are more exposed to higher market risk than diversified REITs (Ro & Ziobrowski, 2011). This result could imply that there might be a difference in the risk premium between diversified and specialized REITs.

Contrary to CAPM, idiosyncratic risk still matters in REIT excess returns depending on the period (Chaing et al., 2010). This is further supported by Ooi, Wang & Web (2009) who found a positive relationship between idiosyncratic risk and REIT excess returns, implying idiosyncratic risk component is essential in REIT pricing. Based on research by Aharon & Yagil (2019), firm leverage positively impacts the stock return volatility. REIT returns remain exposed to stock-market and interest rate risk. This interest rate risk translates to sensitivity to short- and long term interest rate changes. The sensitivity of REIT returns can be influenced by REIT characteristics such as leverage due to a positive relationship between a REIT risk and degree of financial leverage. REITs that minimize their leverage can only influence their sensitivity to shocks in the stock market and not its sensitivity to interest rate changes (Allen et al., 2000). According to Synott et al. (2019), real estate is demonstrably local and its performance is linked to economic growth, the interrelation between GDP growth, credit- and interest rate cycles are essential to real estate. Combining different regions and countries that are not strongly linked together can mitigate the negative impact by lowering risk.

However, this mitigation is associated with a cost. The paper by Mansi & Reeb (2002) explains that a diversification discount is based on firm risk. Shift where shareholder wealth decreases and bondholder value increases when the firm diversifies because of a loss of value of shareholders. These shift changes can be attributed to coinsurance of firm risk where the risk is shared between among bond- and shareholders (Doukas & Kan, 2006). Lewellen (1971) found that this coinsurance effect is caused by increased debt capacity and tax shields enjoyed by diversified firms compared to specialized firms because of lower risk. To explain these statements: the contingent claims framework is used by Mansi & Reeb (2002) where total firm value is allocated between shareholder- and bondholder value. The contingent claims framework indicates that shareholder equity is considered a call option that can be exercised when the call option's value is larger than the value of debt. The call option is deeper-in-the-money when the value is the maximum difference between the value of the assets and debt and zero. Thus, when the firm has a lower level of debt, the call option is deeper in the money. If the asset value is less then value of debt, the call option is not exercised. When the level of debt is low in a firm, it is associated that it lowers the impact of volatility on the value of shareholder equity as a result of lower firm risk (Mansi & Reeb, 2002).

According to Mansi & Reeb (2002), leverage has an identification role in depicting a diversification discount effect due to risk-reducing effects as a result of coinsurance effect between shareholders and bondholders. Firms that experience higher leverage levels incur a higher diversification discount. Diversification lowers this firm risk because of imperfectly correlated cash flows between different segments, creating a difference value difference between specialized- and diversified firms. When the authors compared the results to a subsample of all-equity firms, no diversification discount is found. Therefore, leverage has an essential role in identifying a diversification discount. Furthermore, that paper indicates that a negative effect on shareholder value in the form of a diversification discount can be captured by using an interaction variable between a firm's leverage level and diversification. Similarly, Doukas & Kan (2006) describe that a global diversification discount is increasing when the leverage level of a firm increases. Firms that geographically diversify across imperfectly correlated local markets are lowering firm risk caused by high leverage levels. Lower firm risk can be seen in that it improves cash flows stability and reduces cash flow uncertainty (Doukas & Kan, 2006).

A value difference between diversified- and single-segment firms with comparable portfolios is found by Lamont & Polk (2001). This value difference between the two can be defined as a diversification discount. It is attributed to differences in expected returns and expected cashflows between specialized and diversified firms. This could be based on differences in expected asset returns that is based on risk, liquidity, tax and wrong prices. (Lamont & Polk, 2001). Capozza & Sequin (1999) found that the diversification discount is based on required returns rather than cashflows by using a sample of REITs. Investors would demand a higher required return when REITs are illiquid. The authors found these differences in excess value, which is the value difference between diversified- and focused REITs, is related to differences in liquidity.

The degree of diversification impacts the skewness in returns of a firm, where focused firms had a more prominent exposure to skewness than diversified firms. Skewness has to do with the up- or downside variance potential in returns. However, the lower the skewness, the higher the diversification discount, because investors would be willing to pay a premium for specialized firms that have higher upside potential in returns. As a result, investors are willing to discount diversified firms with the loss of this upward potential in returns. This difference in skewness between focused- and diversified firms explain 53% of the difference in excess returns (Mitton & Vorkink, 2010). However, the natural question remains whether higher skewness for specialized REIT results in higher REIT excess returns compared to a diversified REIT.

The importance risk reduction hypotheses tested by Mansi & Reeb (2002) and Doukas & Kan (2006) for firms makes research about risk mitigation and skewness exposure crucial for REITs during market shocks such as the Covid-19 pandemic (Uddin et al., 2021). In addition, the trend of more developed REIT countries with different institutional and economic conditions, the rise of international REITs, and potential future crises make geographical diversification more relevant in the risk management of REITs and investors.

In this dissertation, the mechanism whether higher leverage and diversification result in lower excess returns for REITs is investigated by using an established model for leverage and REIT returns by Giacomini, Ling & Narjanjo (2015). The model is augmented with diversification factors, with specific focus on the interaction variable between leverage and diversification as measured by Mansi & Reeb (2002). Besides focusing on leverage and diversification, Giacomini, Ling & Narjanjo (2015) measure access to capital in the form of financial constraints on excess returns. Financial constraints are integrated into this paper as well. Giacomini, Ling & Narjanjo (2015) uses Fama French factors and country factors for systematic risk.

The sample analyzed consists of 2579 REIT return observations in 15 countries worldwide over 29 years from 1991-2019. Thereby integrating multiple crisis periods, such as Dotcom and Great Financial Crisis, and countries for relevancy. Furthermore, two fixed effect panel regression models are introduced for comparison and allocated within a pooled group covering three continents: North America, Europe and the Asia Pacific.

To summarize, the research aims to identify a negative diversification discount effect by estimating the effects of the mechanism between geographical diversification and leverage on the excess returns of REITs. From Mansi & Reeb (2002), the diversification discount is based on firm risk and that geographical diversification can lower this firm risk. The level of leverage is a function of the diversification discount as this increases firm risk. Australian REITs used debt to grow aggressively to improve returns. Though, the Australian REITs that had lower debt compared to equity managed to lower their risk and improved returns (Newell & Peng, 2009). Capozza & Sequin (1999) found that the diversification discount is based on required returns rather than cashflows by using a sample of REITs, making it plausible that the diversification discount effect can be detected in REIT returns. This further supported by the sensitivity of leverage to changes in the stock market on REIT returns by Allen et al. (2000) and the claims by Synott et al. (2019) that real estate is demonstrably local and combining different regions would lower risk. Diversification also affects the skewness in returns where a higher diversification discount is detected for lower skewness in returns by diversified firms compared to highly skewed returns by specialized firms (Mitton & Vorkink, 2010).

Leverage increases the volatility of stock returns (Aharon & Yagil 2019). Based on the risk reduction hypothesis tested by Mansi & Reeb (2002) and Doukas & kan (2006), there is likely to be a difference in REIT returns between diversified and focused firms because of lower firm risk based on the correlation of the idiosyncratic risk components at the expense of a diversification discount. Lamont & Polk (2001) describe that the diversification discount, which is a value difference between single-segment and diversified firms of comparable portfolios, is based on differences in expected asset returns that is based on risk, liquidity, tax and wrong prices. Furthermore, the difference is also based on expected cash flows.

Consequently, it is expected that REITs decrease their sensitivity to market risk and, therefore, lower excess returns as the risk premium decreases (Allen et al., 2000). The impact on excess returns is tested by using an interaction variable between leverage and geographical diversification, as this procedure was done by Mansi & Reeb (2002) in identifying a diversification effect.

The main results of our study indicate that leverage has a positive relationship with a REIT's excess returns for the pooled, European and Asian Pacific continent. In addition, further geographical specialization increases excess returns for REITs for the pooled- and European group. The interaction between leverage and geographical diversification is negatively significant for the pooled- and European groups, confirming the negative diversification effect. Robustness analysis specifies that medium- to high leverage REITs incur a negative diversification discount effect on excess returns when applying geographical diversification. These findingsconfirm the argument by Mansi & Reeb (2002) that higher discount diversification is detected when leverage levels increases. In addition, leverage and geographical diversification are found positive for medium- and high leveraged REITs. Further analysis on period subsamples shows no evidence of a diversification discount effect. For diversification level subsamples, firms that are specialized show a negative significant effect by this diversification discount. When regressing different diversification levels, specialized firms have a negative interaction effect diversification effect on REIT returns. However, no diversification discount is present when the firm is already diversified at any level, suggesting that only specialized firms incur a negative diversification discount effect. Further analysis on subsampling 1991-2019 into three periods provided no significant effects for leverage, geographical diversification, or the interaction variable between the two on REIT excess returns.

The contribution by this research to the current literature is added in the following ways. Firstly, the role of geographical diversification in risk management for high leverage REITs has been identified. It combines a diversification discount effect method by Mansi & Reeb (2002) within an established leverage/return model developed by Giacomini, Ling & Narjanjo (2015). This results in a more extensive model to explain REIT excess returns. Secondly, the number of countries in the sample worldwide is expanded by using DataStream index and firm-level data from 1991-2019. Finally, the expanded timeline gives more empirical insights into other REIT crisis periods instead of focusing on the great financial crisis. This chosen timeline gives a long-term perspective on the effect of the mechanism on REIT excess returns to compare it with shorter periods in the results section.

These contributions are relevant because leverage exposes investors to firm-specific risk. Increased leverage risk is amplified by global debt levels because of the Great financial crisis and the Covid-19 crisis (Parker, 2021) Parker (2021) wrote that the Covid-19 crisis increases the sovereign debt burden and can affect interest rates leading to long-term negative interest rates. In addition, corporate debt has increased to 96 percent in lower-income countries and affects a company's ability to tackle changing market conditions. REITs use short-term financing instruments that are required to roll over borrowings, leaving the REIT vulnerable in a time when market stress is present (Schnure, 2019).

Leverage is significant on REIT returns, except for the financial crisis where increased leverage resulted in lower share prices (Giacomini et al., 2015). However, during the 1994-2006 period, REITs that increased leverage increased financial risk. As a result, volatility increased. After 2007, REITs have delivered because there is a relationship between an increase in REIT stock prices and a decrease in equity volatility (Kawaguchi et al., 2017). REITs with minimal financial leverage are less sensitive to changes in the stock market (Allen et al., 2000). According to Giacomini et al. (2017), A REIT's leverage return performance is conditional on deviations by its target leverage. Results indicate that highly levered REITs that are above their target leverage perform better compared to REITs that are under their target leverage. Although, REITs that are levered above their target leverage are performing, adjusting for risk basis, better than firms that are unlevered. This finding is also confirmed by Pavlov, Steiner & Wachter (2018) that illustrated those higher cumulative returns were generated by REITs that adjusted their capital structure by deleveraging before the crisis. When leverage turns into financial distress, the risk is not rewarded with additional risk premium or systematic risk and returns are lower than safe REITs (Shen, 2021).

Studies describe the reluctance of firms to diversify, even though markets are more integrated and efficient. Many REIT portfolios are only composed of domestic assets, whereas foreign portfolios are not preferred (French & Poterba, 1991). Two phenomena explain this preference for geographic specialization. Firstly, entering other markets increases information costs because of market imperfections that lead to sub-optimal investments (Turnbull & Sirmans, 1993). Secondly, specialized REITs in one geographical area experiences higher operation efficiency and lower operational costs (Anderson et al., 2002). Findings by Yong et Al. (2009) illustrate that specialized firms in both sectors and geographical locations generate higher returns for investors. Firms that focus on one sector are valued at a premium compared to diversified firms (Hedander, 2005).

Diversification results in a loss of value for corporations because the benefits resulting from diversification result from interest tax shield and offsetting losses from other sectors (Berger & Ofek, 1995). Other academic literature contradicts the benefits of specialization. There is evidence by Gibilaro & Mattarocci (2016) that home bias or geographic specialization does not always result in higher returns, persistence, or profitability. However, this effect varies per country where Europe and the U.S. experience a home bias premium. Ziobrowski & Curcio (1991) argued that diversification benefits are eliminated by exchange rate risk.

This dissertation is structured as follows. Firstly, section 2 provides theory is provided regarding stock returns plus the factors for model building. This is followed by a chapter about the dependent variable: total investment return and the measurement for diversification. Section 3 explains the REIT data obtained and possible issues concerning the dataset and source. The results are presented in section 4 using a panel regression that includes multiple sub regressions and a robustness check. Section 5 discusses the related findings of section 4. Finally, section 6 concludes this dissertation followed limitations and future recommendations.

2. Modeling real estate returns and diversification

The foundation of the mechanism between leverage and diversification is needed to identify a negative diversification discount effect on REIT excess returns. Conducting a model that measures both systematic and idiosyncratic factors in capturing a stock's excess return is required to identify a negative diversification discount effect.

In Berk & Demarzo (2016), it is explained that the risk premium of a stock is given by market risk as idiosyncratic is deemed to be diversified away and not compensated for. The impact of idiosyncratic risk on REITs is elobarated in a paper by Ooi, Wang & Webb (2009). Idiosyncratic volatility and cross-sectional returns are positively related when controled for size and book-to-market ratio. Furthermore, the idiosyncratic risk of REITs is time-related, according to Chaing et al. (2010). Chaing et al. (2010) refer to two periods: the vintage era in 1980-1992, where an upward trend was identified. In the new REIT era from 1993-2006, a downward trend was found where REIT excess return was negatively related to idiosyncratic risk.

A security's return comprises the risk-free rate plus the risk premium (Mullins Jr., 1982). As described in Kuhle (1987), diversification in lowering the risk of a portfolio can be assigned to modern portfolio theory by Markowitz (1952). Two components are essential in measuring the risk-return relationship. Firstly, return is a function of price and dividend:

$$R_i = [(P_{i1} - P_{i0}) + D_{i1}]/P_{i0} \tag{1}$$

R_i in formula (1) represents the asset's return, the asset price today P_{i0}, the asset price of tomorrow P_{i1}, and the dividend paid over the asset D_{i1}. Thus, the standard deviation of the portfolio is given by:

$$\sigma p = \sqrt{\sum_{i=1}^{n}\sum_{j=1}^{n} x_i x_j \sigma_{ij}} \tag{2}$$

This case σp in formula (2) represents the portfolio standard deviation *xi* and *xj* represents the weight invested in each asset class. The rationale behind the formula would be that if an investor knows the future return variances of the portfolio, it will allocate unequally over both asset classes in achieving the lowest standard deviation. Thereby experiencing the lowest portfolio risk (Kuhle, 1987). Volatility in the stock is driven by the risk premium that captures the total risk of a stock or portfolio (Berk & DeMarzo, 2016).

In assessing REIT performance and diversification, Coskun et al. (2017) used the Fama French five factor model (2015) due to its performance in capturing the variation in REIT returns. Other factors models that would capture systematic risk adjustments are the CAPM and 4 factor model by Carhart (1997) (Zhou & Ziobrowski, 2009). Analyzing returns of single stocks or portfolios, such as the Fama French five-factor model, have been used as common risk factors to explain stock returns. As explained in the five-factor paper by Fama & French (2015), Sharpe (1964) & Lintner (1965) were the first ones to develop the CAPM model that used the market risk premium to explain excess returns. Furthermore, the Fama French three-factor model incorporated size and book-to-market equity into the model (Fama & French, 1993). There is evidence by Peterson & Hsieh (1997) that all factors three Fama-French factor model are significant, making the three Fama-French factor model still relevant to seek for explanatory power for REIT returns. In the five-factor model, Fama & French (2015) add both investment and profitability factors to the following model in formula (3):

$$R_{it} - Rf_t = a_i + b_i(Rm_t - Rf_t) + s_i SMB + h_i HML + r_i RMW + c_i CMA + e_{it} \tag{3}$$

Formula (3) explains that a portfolio or single returns of stocks R_{it} minus the risk-free rate Rf_t gives the excess return. $b_i(Rm_t - Rf_t)$ gives the market portfolio excess return.. SMB measures the return of a diversified portfolio consisting of small- minus big stocks. The third factor, HML, is a portfolio factor that represents a low and high book/market value stock. RMW is the fourth factor and accounts for the difference between robust and weak profitability stocks. The last factor, CMA, is the difference in stocks that are considered low and high investments (Fama & French, 2015). The regression framework for this research contains several factors that combine the selection of Fama French factors, country- and firm-specific factors. These factors are further motivated by relevant literature in appendix 3.

2.1 Total investment return

In analyzing REIT performance, the first step is obtaining return data from REITs following a measure as formula 1 in chapter 2.1. Simple returns are calculated as the sum of price shifts and dividends. Fama & French (2015) use simple returns and not log returns. So, this research keeps simple returns and delete outlier effects from very high returns. Total investment return is the dependent variable because a diversification discount effect can be applied to excess returns. Therefore, a return measure is needed that is not biased by continuously compounded returns. The database supporting this type of data is DataStream Refinitiv. Time series inquiries on DataStream have been used to obtain this variable. The search narrowed to REIT equities in the countries selected for the period 1991-2019. Total investment return is calculated by the following formula (4):

$$\begin{aligned} &Total\ investment\ return_{i,t} \\ &\quad = (market\ price\ year\ end\ +\ dividends\ per\ share\ +\ special\ dividends\ \ quarter\ 1 \\ &\quad +\ special\ dividend\ quarter\ 2\ +\ special\ dividend\ quarter\ 3 \\ &\quad +\ special\ dividend\ quarter\ 4)\ /\ last\ years's\ market\ price -\ year\ end\ - 1)\ * 100 \end{aligned} \tag{4}$$

This performance ratio makes it possible to have a benchmark that is not continuously compounded every year. Instead of calculating all price movements and dividends separately, combining the two into one variable enables this research to have complete information on returns. A requirement to use both separately would be the availability of both price shifts and dividends data for REIT *i* at time *t*. Otherwise, bias could be present where some returns are underestimated as a result of missing information. So, by using total investment return from DataStream, complete information on returns is assured to prevent bias.

The disadvantage for choosing total investment return is the annual format. More observations are available for daily, monthly or quarterly data. This sacrifices more observations over time. Another disadvantage could be the inclusion of a special dividend that is embedded. This could overestimate performance in some years, resulting in potential overestimation problems. However, some structural breaks happen in time series data. Comparing this to daily or monthly data, the same problem would have occurred where price shifts are dominant in determining returns and dividends as a structural break effect. This is because dividends are not paid every day or month. As a result, data management on total investment return focuses on outlier effects based on percentiles. These outlier values are deleted from the dataset. Returns can be seen in table 1 in chapter 3.1.

2.2 Diversification

The Herfindahl index serves as a tool of diversification in which a weight is allocated to each region. This quantification of diversification aims to measure the degree of diversification in continuous form by using a value between 0 and 1. Ambrose et al. (2000) and Cheok et al. (2011) have used the Herfindahl measure to assess geographical concentration for REITs. This paper uses the same index and notation of the values. Both authors explain that a value of 1 equals full concentration and a value lower than 1 and above 0 indicates diversification. Applying a dummy variable would miss out on the degree of diversification on excess returns as the intensity of diversification differs. However, it would still be a valid option as other diversification literature, such as Kuppuswamy & Villalonga (2016), also applied it as a dummy.

Using DataStream has its limitations since the data obtained does not provide any holdings or transactional data. Instead, the time series tool in Excel from DataStream enables to query a data series request based on different sorts of geographical segments. It could allocate 'sales,' 'capital expenditure,' 'operating income' and 'depreciation' to firm *i* in year *t* from minimum of 1 to a maximum of 10 geographical segments, which generates its own assets. The measurement of choice is 'assets' because it is a valid choice for REITs. For the query, all REITs in country *i* need to be selected and all segment categories need to be turned on. Once all segments are loaded for each REIT firm, the cleaning process starts. Segments that issue an error statement and show no data for that specific segment are not existing. For example, REIT *i* in the Netherlands show different segments for each year. In 2000, REIT loads 3 segments, leaving the other 7 empty, therefore non-existing. In 2001, the number of segments loaded increases to 4, indicating that REIT *i* expanded their diversification in more geographical segments. Every year total asset value changes and segments are added and dropped. This gives a transparent insight into the number of segments a REIT is active in, including the total value of all assets in that specific segment. Once the segments are loaded the data is not measurable yet. First, all total asset values per geographical segment per REIT per year are transposed into panel columns. After the cleaning, the Herfindahl index formula is used for the weight calculations of all asset values. The formula, according to Ambrose et al. (2000), indicates a particular concentration among the sum of the weights in the following formula (5):

$$geodiv_{i,t} = \sum_{j=1}^{m} \left(\frac{X_{ij,t}}{X_{i,t}} \right)^2 \tag{5}$$

Geodiv is comprised of the sum of weighted squared segments of REIT *i* at time *t*. *m* stands for the number of geographical segments covered by DataStream, which is 10. Xij,t stands for the asset value of segment j for REIT i at time t. Xi,t stands for the total asset value of all segments together.

2.3 regression framework

Based on the previous chapters, a model that captures a risk premium is needed in assisting the research in finding a negative diversification discount effect. Fama French factors and country variables capture systematic risk. In addition, idiosyncratic factors are captured by using firm data of the REIT sample.

Beforehand, Giacomini, Ling & Naranjo (2015) investigated the relationship between leverage, REIT returns and financial constraints into one model. It utilized a fixed effect panel regression to control unobservable time variants and firm-level characteristics. The new regression framework in this research attempts to enhance the established leverage model. Firstly, this is done by adding geographical diversification to capture its effect on REIT excess returns and to use the mechanism between leverage and geographical diversification. In addition, Secondly, Fama-French five-factor model is applied instead of the three-factor model. Thirdly, a more extended timeframe that includes more crises and prosperous periods could give more relevance to the long-term effects of the variables in the model. Previously, Giacomini, Ling & Naranjo (2015) investigated monthly data for 2002-2011, including the financial crisis. Finally, adding the countries into continental groups gives a more representative outcome for this research.

The goal of the augmented panel model, which is based on an established leverage/REIT return model by Giacomini, Ling & Naranjo (2015), is to add significance and explanatory power to REIT excess returns by capturing a risk premium on excess REIT returns. The effects of the crisis are controlled by using a dummy variable. The regression framework is formulated as follows in formula (6):

$$r_{i,t} - r_{f_{i,t}} = \beta_0 + \beta_1 (r_m - r_f)_{t-1} + \beta_2 SMB_{t-1} + \beta_3 HML_{t-1} + \beta_4 RMW_{t-1} + \beta_5 CMA_{t-1} + \beta_6 MOM_{t-1} + \beta_7 financial\,freedom_{t-1} + \beta_8 inflation_{t-1} + \beta_9 excessmarketfactor_{t-1} + \beta_{10} leverage_{t-1} + \beta_{11} geodiv_{t-1} + \beta_{12} crisis + \beta_{13} Crisis * leverage_{t-1} + \beta_{14} firmconstraint_{t-1} + \beta_{15} levdiv_{t-1} + \beta_{16} finlev_{t-1} + e_{i,t} \tag{6}$$

Table 2 contains the notations of formula 6. Providing the abbreviation and definition of the variable including the source where it is obtained. The dependent variable is excluded from the table because it has been covered extensively in chapter 2.1. This also applies to diversification in chapter 2.2. Further relevant literature for using the factors in the above model are given in appendix 3.

Table 1 dependent variable has been excluded. The first column indicates the variable name. The second column gives a short description of the function and calculation of the variable. Finally, the third column contains the source of the variable.

Fama French factors (regional)		
Mkt-rf $(r_m - r_f)$	Also known as the excess return of the market portfolio. It is given as the value weighted return minus the risk-free rate in the form of US treasury rate.	Kenneth R. French library
SMB **Small minus big**	Measures the return tradeoff for investing in smaller companies' capitalizations portfolios.	Kenneth R. French library
HML **High minus low**	Value premium for the higher book to market ratios portfolios.	Kenneth R. French library
RMW **Robust minus weak**	Also known as the profitability factor. It encompasses the average return between robust- and weak operating profitability portfolios.	Kenneth R. French library
CMA **Conservative minus aggressive**	The average return between two aggressive and two conservative investment portfolios.	Kenneth R. French library
MOM **Momentum**	Momentum takes the difference of the average return of the high and low prior return portfolios (Anon., sd)	Kenneth R. French library
Firm characteristics		
Firm Size	Size of total assets of a REIT converted to natural logarithm.	DataStream Refinitiv
Firm age	Based on year *t* minus the year of inception of the REIT.	Google
Leverage	Book value in the form of a percentage of total debt to total assets of REIT *i* at year *t*.	DataStream Refinitiv
Country characteristics		
inflation	increase in consumer prices in percentages compared to year *t-1* of country *i*.	Worldbank.org
Financial freedom	Financial freedom measures accessibility for business to obtain	The Heritage Foundation

	capital and government involvement in the financial system. It is measured in a score between 0 and 100 for country *i* at year *t*.	
Local Market factor	Based on the annual return of the local stock market of country *i* at year *t* where REIT *i* is domiciled.	1stock1
Crisis	A dummy variable with the value of 1 when a crisis year occurs. Crisis years are 1991, 2000 till 2002 and the Great Financial Crisis from 2007 till 2009.	Google
	Interaction variables	
Crisis_leverage	An interaction variable that crosses the crisis dummy with leverage, calculated as book leverage of REIT *i* at year *t*.	-
Firm constraint	An interaction variable that multiplies log firm size with firm age of REIT *i* at year *t*.	-
Levdiv	An interaction variable that interacts leverage with geographical diversification level of REIT *i* at year *t*.	-
Finlev	An interaction variable between financial freedom, given in a score between 0 and 100, and leverage, the book leverage of REIT *i*.	-

Similar to the method and finding of Mansi & Reeb (2002), the expected result that assists the research would be a negative significant interaction variable for levdiv, which is the interaction between leverage and geographical diversification, for all regressions. This result would support that higher leverage levels and diversification lower excess returns, which shows the impact of a diversification discount effect. Furthermore, the positive significance of leverage and geographical diversification on excess REIT returns assists the research aim.

Like Giacomini, Ling & Naranjo (2015), all regressions have been implemented with fixed effects covering entity and country. Time-fixed effects have been captured by year dummies to capture the full extent of unobservable individual heterogeneity of the panel data. Thus, a fixed effect panel regression is suited for this dataset and research aim.

Research methods that were considered, such as OLS or Fama-Macbeth, encounter problems based on the type of data and diagnostics. The problem with Fama-Macbeth is that it utilizes OLS first for a large panel of 29 years. Subsequently, the presence of autocorrelation is present and not corrected. Therefore, based on the diagnostics in appendix 2, a fixed effect panel regression is desired and clustered standard errors.

Extensive diagnostics by Giacomini, Ling & Naranjo (2015) are absent. The authors only specify a bias in using market leverage by a relationship mechanism in the returns and leverage. Leverage is calculated in the form of market leverage. Unlike the choice of using market leverage in that model, we will not choose this calculation of leverage for endogeneity issues as was recognized by the authors. Instead, this model will use book leverage to mitigate this bias. The paper itself describes the use of fixed effects in firm entities. Heteroskedasticity and autocorrelation are problematic and results in inefficiency issues. If presence is detected, all regressions are equipped with robust standard and clustered effects of eliminate autocorrelation. Heteroskedasticity could be present in the form of overestimation because of some outlier effects in variables. Therefore, some variables with high skewness have been corrected by log numbers and all results are corrected with robust standard errors. More details about the variables and summary statistics are discussed in the next chapter.

The data has been organized in a large macro panel, so it remains hard to ignore the time effect presence. Likewise, with the return/leverage model by Giacomini, Ling & Naranjo (2015), lagged variables have been applied for all our variables as stated with *t-1*. In addition, introducing lagged return as an independent variable in every can help reduce the autocorrelation effect in the panel data based on the result in appendix 2. Importantly the incorrect specification of random- or fixed effects can result in inconsistent results. Therefore, the Hausman test is employed to see whether fixed- or random effects are appropriate to use. The last test is the inclusion of time-fixed effects by using the '*testparm*' command in Stata. The model contains a crisis variable as a dummy variable to isolate the effects on REIT excess returns. The time dummies are meant for the years not captured by the crisis years for time fixed effects.

Other potential endogeneity problems could arise from this type of REIT performance research. Specifically, sample bias that is embedded in survivorship bias. Two papers specifically write about this issue concerning performance studies—Carhart (1997), where the author uses a free survivorship bias sample. The author includes all known mutual funds in the period of the sample. Similarly, this research chooses well-known public REITs listed in the country of origin and recorded by DataStreamAnother point that Carhart (1997) makes the case is sample selection bias that could either result in upward or downward bias of returns.

For the sample used in this research, most of the selection bias is directly derived from the Refinitiv DataStream system and the Fama French factors. Not all Fama French factors, cover all countries worldwide. So, some REIT countries are excluded from the sample group. Selection filters have been applied to tackle this selection bias to integrate as many REITs as possible from every target country. Firstly, using panel data over a more extended period involving multiple countries enables this research to have enough observations from different regions. To tackle survivorship bias, no distinction is made between REITs with track records of 1 year or REITs that have a 29-year record. So, all REIT records of at least 1 year have been integrated in the dataset. This results in an unbalanced panel but deals with survivorship bias. The selection bias that DataStream generated was that not every investment return observation was available that led to a further unbalanced panel. Though this problem depends on the quality of the data source. It could be that some countries are overrepresented in the sample by having a more extensive track record on developed REIT markets. However, these effects are mitigated based on different controls and sub-samples in the analysis section in chapter 4.

The dataset comprises Australia, Belgium, Canada, Germany, Denmark, France, Greece, Hong Kong, Ireland, Italy, Japan, Netherlands, New Zealand, Portugal, Sweden, Singapore, Spain, United Kingdom and the United States. Instead using country regressions like Giacomini, Ling & Naranjo (2015), continents are used based on the assumption that real estate markets are becoming more integrated (Eichholtz et al., 1998).

3. REIT Data

The data source Refinitiv DataStream is selected based on the availability of public REIT data. It is linked to other REIT performance studies such as Giacomini, Ling & Naranjo (2015). DataStream is suitable for REIT returns and firm-specific data such as firm size, leverage and geographical diversification. Giacomini, Ling & Naranjo (2015) acknowledge that the availability of REIT firms' observations varies per year and country.

Other REIT papers that use DataStream as a data source are Loo, Anuar & Ramakrishnan (2016) and Tsai & Lee (2012). Like Tsai & Lee (2012), this research incorporates all return data in local currency to prevent exchange rate risk problems. Otherwise, returns are biased by exchange rate risk based on the U.S. dollar that specialized REITs do not incur. Furthermore, returns in ratio form do not affect the return size like absolute returns. So, all returns values are calculated in decimals by using formula 4 in chapter 2.2.

The first step is obtaining the returns from 15 REIT country for 29 years in annual form. Appendix 1 contains descriptive statistics for all countries and years involved. Countries that are integrated in the dataset are: Australia, Belgium, Canada, Germany, Denmark, France, Greece, Hong Kong, Ireland, Italy, Japan, Netherlands, New Zealand, Portugal, Sweden, Singapore, Spain, United Kingdom and the United States. These countries are selected based on the coverage by the regional Fama French factors. Countries that would have REIT return data but no coverage by the Fama French regional factors are excluded. The period used ranges from 1991 till 2019. Some of the data points for entity *i* at time *t* are not available and results in an error code when it is not available or existing. Subsequently, all missing observations are loaded again on DataStream to ensure a technical error does not cause it. In the case of a second error code, the observations are deleted. All usable returns are sorted through REIT name and year in panel columns. The next step is to obtain other firm characteristics such as size, leverage and geographical diversification. These variables, except for diversification, have been directly retrieved and integrated into the panel columns. Subsequently, each firm has been similarly cleaned and allocated like the returns. Finally, returns, leverage and diversification are converted into decimals.

When finished, all variables with the corresponding entity and year have been added in the panel columns. For the analysis, the statistical software of Stata 16.0 is used. The benefit of using Stata is that it filters the observations that are usable and complete in its estimations. Giacomini, Ling & Naranjo (2015) also indicates dropping missing values for their sample. Therefore, all missing observations for all variables have been dropped, as shown in table 1. To make the research feasible, at least one lagged observation per entity needs to be present to be integrated in the sample.

Table 1 descriptive statistics of the dependent variable excess return and the independent variables in the model

Descriptive Statistics

Variables	Obs	Mean	Std.Dev.	Min	Max
Excess Return	2579	.115	.312	-.987	3.034
MktRF	2579	.079	.187	-.53	.809
SMB	2579	.006	.091	-.269	.288
HML	2579	.009	.131	-.334	.501
RMW	2579	.04	.077	-.207	.255
CMA	2579	.014	.107	-.457	.459
MOM	2579	.062	.192	-.75	.561
Financial Freedom	2579	.764	.105	.4	.9
Inflation	2579	.019	.011	-.017	.066
Market factor	2579	.055	.169	-.554	.644
Leverage	2579	.485	.202	0	2.284
Log size	2579	6.284	.884	3.359	9.066
Log firm age	2579	1.297	0.371	0	2.215
Geographical diver~	2579	.952	.154	.114	1

The dataset in table 1 consists of 2579 REIT return observations of 252 REITs over 15 countries. Appendix 1 contains the tabulations of the dataset. Table 2 in appendix 3 summarizes the definition and function of the model's control- and interaction variables. Cleaning the data is only based on outlier effects and Stata eliminates missing values in the regression. After cleaning the data, multiple independent variables with high percentiles, such as most firm characteristic variables, are converted to natural logarithms. All these variables have been assigned with a log in the variable name. Finally, the rest of the variables have been inspected and cleaned of excessively skewed observations leading to biases.

The tables in appendix 1 illustrates an increasing number of observations, with most observations captured in 2019. Australia, Canada, Germany, Great Britain, Netherlands, and the USA encompasses a developed market ranging from 1991-2019, whereas countries like Spain, Ireland and New Zealand have observations ranging from 2015 to 2019. The sample also illustrates a clear presence of the US REIT market, which almost covers half of the observations in the sample. For this research, a portion of diversified REITs is needed to estimate the effect. In absolute numbers, the U.S. has the most observations, though some European and Asia Pacific countries have more diversified firms proportionally to the total number of REIT firms in that country.

4. Results

Based on the Hausman test in appendix 2, a fixed panel regression is utilized. The fixed panel regression is depicted in table 3. It contains all the results of the pooled and regional sample groups. The regions regressed are North America, Europe and Asian Pacific. Column 1 & 2 represents the pooled sample, which includes all regions. Columns 3-8 reports the estimations per region applying within-country firm-level data of our baseline panel regions. All independent variables listed above are regressed against the dependent variable a REIT *i*'s excess return in year *t*. Definitions of the variables are in table 2 at chapter 2.3. The panel regression was performed using fixed effects for countries and firms to control all hidden time-varying and locational effects. Lagged variables is based on one year.

Furthermore, all standard errors have been clustered by REIT entity number and robust and are reported in parenthesis under the beta coefficient values. The rows below the table indicate the model fit in the form of adjusted R-squared, Firm fixed effects, integrated year dummies to capture time fixed effects, and a one-year integrated lagged return variable. The choice for continental subgroups stems from the paper by Eichholtz et al. (1998) that searched for continental factors that co-move international real estate returns to provide diversification benefits. Two models are created per group in the form of M1 and M2. M1 serves as a baseline model where M2 serves as an augmented model that introduces more interaction variables for comparision.

Table 3 model 1 encompasses all leverage and crisis variables. Model 2 introduces more interaction effects. Pooled group model represents the first two columns. Subsequently, sub-groups have been made on a regional basis for regression 3 till 8. The dependent variable is the excess return of REIT i in period t is not lagged.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Pooled M1	Pooled M2	NA M1	NA M2	EU M1	EU M2	AP M1	AP M2
MktRF t-1	-0.433***	-0.435***	-0.137	-0.126	2.666	2.625	0.0254	0.0324
	(0.126)	(0.127)	(0.224)	(0.223)	(2.488)	(2.481)	(0.232)	(0.227)
SMB t-1	0.588***	0.567***	0.560	0.544	17.85*	17.59*	0.0777	0.0979
	(0.115)	(0.119)	(0.430)	(0.437)	(9.673)	(9.608)	(0.274)	(0.266)
HML t-1	0.0432	0.0522	-1.010*	-1.034*	-10.96	-10.81	-1.223*	-1.182*
	(0.156)	(0.163)	(0.540)	(0.555)	(7.343)	(7.298)	(0.692)	(0.672)
RMW t-1	-0.132	-0.137	-0.772***	-0.787***	6.182*	6.135*	-0.204	-0.239
	(0.131)	(0.133)	(0.245)	(0.243)	(3.344)	(3.357)	(0.259)	(0.254)
CMA t-1	0.141	0.128	1.659***	1.651**	20.77	20.35	0.870	0.875
	(0.167)	(0.179)	(0.599)	(0.632)	(14.16)	(14.08)	(0.570)	(0.557)
MOM t-1	0.114	0.107	0.0368	-0.0127	-3.994*	-4.026*	-0.236	-0.201
	(0.0983)	(0.0977)	(0.363)	(0.353)	(2.129)	(2.115)	(0.258)	(0.251)
financialfreedom t-1	-0.273**	-0.0895	-0.382	-0.255	0.303	0.582	-0.0467	0.648
	(0.131)	(0.169)	(0.349)	(0.345)	(0.356)	(0.394)	(0.288)	(0.619)

inflation t-1	-0.634	-0.606	4.690	4.974	0.356	0.545	4.515**	4.505**
	(1.030)	(1.018)	(4.231)	(4.179)	(2.584)	(2.658)	(2.104)	(1.996)
excessmarket t-1	-0.0194	-0.00781	-0.598**	-0.601**	0.348*	0.370*	0.0267	0.0107
	(0.115)	(0.114)	(0.247)	(0.249)	(0.204)	(0.202)	(0.172)	(0.176)
leverage t-1	0.0263	1.619***	-0.0192	0.736	0.0874	3.219***	0.344***	1.869
	(0.0512)	(0.434)	(0.0419)	(0.709)	(0.175)	(0.718)	(0.110)	(1.492)
logsize t-1	-0.0826**	-0.0669	-0.0300	0.0504	-0.0150	0.0756	-0.736***	-0.683***
	(0.0374)	(0.0892)	(0.0426)	(0.115)	(0.0526)	(0.110)	(0.169)	(0.214)
firmage t-1	-0.0294	0.0381	-0.0232	0.361	-0.109	0.143	-0.134	0.0134
	(0.0565)	(0.313)	(0.0577)	(0.434)	(0.115)	(0.315)	(0.206)	(0.751)
geodivers t-1	0.0216	0.688***	0.00188	0.324	-0.0404	1.318***	-0.0758	-0.112
	(0.105)	(0.192)	(0.116)	(0.309)	(0.203)	(0.352)	(0.205)	(0.336)
Crisis	-0.274***	-0.275***	-0.222***	-0.258***	-1.497	-1.499	-0.619***	-0.635***
	(0.0527)	(0.0525)	(0.0826)	(0.0847)	(0.950)	(0.941)	(0.190)	(0.193)
crisis_leverage t-1	-0.0262	0.00564	-0.0799	-0.0503	-0.120	-0.0216	-0.325	-0.342
	(0.0706)	(0.0735)	(0.0901)	(0.0956)	(0.165)	(0.169)	(0.358)	(0.452)
levdiv t-1		-1.443***		-0.643		-3.047***		0.202
		(0.447)		(0.724)		(0.726)		(0.885)
firmconstraint t-1		-0.0116		-0.0721		-0.0501		-0.0305
		(0.0548)		(0.0798)		(0.0661)		(0.117)
finlev t-1		-0.372**		-0.231		-0.492*		-1.969
		(0.147)		(0.154)		(0.279)		(1.383)
Constant	0.973***	0.141	0.583	-0.200	1.716	-0.223	5.608***	4.729***
	(0.321)	(0.594)	(0.539)	(0.828)	(1.152)	(1.298)	(1.351)	(1.690)
Observations	2,579	2,579	1,536	1,536	486	486	557	557
Adjusted R-squared	0,2	0,2	0,292	0,294	0,275	0,296	0,222	0,222
Number of entities	252	252	104	104	61	61	87	87
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES
Return lags	YES	YES	YES	YES	YES	YES	YES	YES

NA = North America, EU= Europe, AP =Asia Pacific

Clustered standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The pooled model M1 depicts a negative significance for the first Fama French factor MktRF at the 1% significance level. Furthermore, SMB is positively significant for the 1% significance level. Financial freedom shows a negative statistical significance at the 5% significance level for the pooled M1 model. Log size is negatively significant at the 5% level, which contradicts Conover et al. (1998) that increasing firm size increases returns. Like Giacomini, Ling & Naranjo (2015), crisis is negatively significant at the 1% level, implying that periods of crisis lower REIT excess returns.

The first Fama French factor MktRF is negatively significant at the 1% significance level for the pooled M2 model. In addition, the SMB estimator is positively significant at the 1% level. Both results are similar in Pooled M1. Leverage is positively significant at the 1% level, implying that REITs that increase leverage levels increase excess return for investors. This result is also in line with Giacomini, Ling & Naranjo (2015) and Shen (2021). Geographical diversification is positively significant at the 1% level. This indicates that when REITs further specialize geographically than excess returns increase. This result is consistent with Yong et al. (2009). The coefficient for crisis is negatively statistically significant at the 1% significance level for the pooled M2 model. Contrary to Giacomini, Ling & Narjano (2015), no significance is found when interacting with leverage. The interaction variable for leverage and geographical diversification levdiv is negatively significant at the highest level of 1%. This result is consistent with Mansi & Reeb (2002) and Doukas & Kan (2006), implying that the result aligns with the risk reduction hypothesis. In addition, the interaction term levdiv changes the significance and magnitude of the coefficient leverage and geographical diversification. The result indicates that for higher leverage levels and geographical diversification, a negative effect on excess returns should occur. The interaction term between financial freedom and leverage is negatively significant at the 5% significance level, indicating that when leverage levels increase and financial freedom is low, it decreases REIT excess returns.

The estimator HML is negatively significant for the North American M1 model at the 10% significance level. The Fama French five factors RMW and CMA are significant at the 1% level, in which RMW is negatively significant and CMA positively significant. This supports the notion by Buttimer Jr., Cheng & Chaing (2012) that more risk factors would add explanatory power to the model. Furthermore, compared to the Fama French three-factor model used in Giacomini, Ling & Naranjo (2015), it would add significance to explaining excess returns by adding more Fama French factors for the North American region. The local market factor is negatively significant at the 5% significance level for the Northern American region. These results align with Giacomini, Ling & Naranjo (2015) that found coefficients of both signs for different countries, implying that the risk premia embedded in market returns move along REIT returns risk premia. During times of crisis, the coefficient is negatively statistically significant at the 1% significance level for the North American M1 model. Again, this result aligns with Giacomini, Ling & Narjano (2015).

For the North American M2 model, HML is negatively significant at the 10% significance level. Similar to North America M1, the estimators RMW and CMA remain significant. RMW is negatively significant at the 1% level and CMA is positively significant at the 5% level. The local market factor is negatively significant at the 5% level, which is in line with Giacomini, Ling & Narjano (2015) that found significant market risk premiums with both coefficient signs. Crisis is negatively significant for the 1% significance level, though the interaction variable between Crisis. It provides limited evidence by Giacomini, Ling & Narjano (2015) that found negatively significant coefficients for crisis and the interaction between crisis and leverage. No significance for leverage, geographical diversification or interaction is found for North America M2 model, contrary to the evidence for risk reduction hypothesis by Mansi & Reeb (2002) and Doukas & Kan (2006).

For Europe M1, the SMB estimator is positively significant at 10% significance level. The Fama French five-factor RMW is positively significant at the 10% significance level. However, compared to the previous North America M1 and M2, the coefficient turns positive instead of negative. The significance of the RMW factor also supports the addition of more risk factors to add explanatory power to the model by Buttimer Jr., Cheng & Chaing (2012). Compared to the Fama French three-factor model used in Giacomini, Ling & Narjano (2015), this would also explain REIT excess returns for the European region. Momentum is negatively significant at the 10% level for Europe M1. Thereby supporting the claim by Derwall et al. (2009) that momentum is a determinant of REIT excess returns for the European region. The local market factor is positively significant for the 10% level. This result follows Giacomini, Ling & Narjano (2015) that found significance for the local market factor. Unlike the other models in table 3, crisis is not significant nor is the interaction variable between leverage and crisis. This could be caused by grouping all European countries and that some countries are less affected by the crisis than other countries in the region. This contradicts the findings for the crisis dummy by Giacomini, Ling & Narjano (2015).

SMB is positively significant at the 10% significance level for the European M2 model. The Fama French five-factor RMW is positively significant at the 10% significance level. The significance of the RMW factor is in line with the findings by Buttimer Jr., Cheng & Chaing (2012). Furthermore, compared to the Fama French three-factor model used in Giacomini, Ling & Narjano (2015), this would also add significance in explaining REIT excess returns for the European region. Momentum is negatively significant for the Europe M2 model at a 10% significance level. This confirms Derwall et al. (2009) that momentum is a determinant of REIT excess returns for the European region. The local market factor is positively significant for the 10% level, aligning with Giacomini, Ling & Narjano (2015). Geographical diversification illustrates significant positive results for the European continent at the 1% significance level. This result implies that increasing specialization results in higher REIT excess returns, consistent with Yong et Al. (2009). However, the result for geographical diversification only becomes statistically significant when an interaction variable is introduced. The interaction term for leverage and diversification 'levdiv' is negatively significant for Europe at the 1% significance level. It shows that firms that are highly levered and are diversified are incurring a decrease in excess returns in the form of a negative diversification discount effect, providing evidence for the risk reduction hypothesis by Mansi & Reeb (2002) and Doukas & Kan (2006). The interaction term levdiv changes the significance and magnitude of the coefficient leverage and geographical diversification. The interaction term between financial freedom and leverage is negatively significant at the 10% significance level, indicating that when leverage levels increase and financial freedom is low in Europe, it decreases REIT excess returns.

The only factor of the Fama French five-factor model found to be significant in the Asia Pacific M1 model is HML. HML is negatively significant for the 10% significance level. Unlike the other models in table 3, inflation is positively significant at the 5% level. This is in line with

Mullineaux & Chew (1990) that REITs provide a hedge against inflation. Leverage is found to be positively significant at the highest 1% significance level. This is in line with the findings by Giacomini, Ling & Narjano (2015). Log size is negatively significant for the 1% significance level, contradicting Conover et al. (1998) that increasing firm size increases returns. Crisis is negatively significant at the 1% significance level. However, no significance for the interaction variable between crisis and leverage is found. Thereby partly supports the findings Giacomini, Ling & Narjano (2015) found evidence for both crisis and the interaction variable of crisis and leverage.

For the Asian Pacific M2 model, the only significant Fama French five-factor model is HML. The HML estimator is found to be negatively significant for the 10% significance level. No evidence is found for the RMW, CMA or MOM factor, thereby contradicting Buttimer Jr., Cheng & Chaing (2012) and Derwall et al. (2009). Inflation is positively significant at the 5% level, indicating that REIT excess returns provide a hedge against inflation, aligning with Mullineaux & Chew (1990). Log size is negatively significant at the 1% significance level, thereby contradicting the findings by Conover et al. (1998). Crisis is negatively significant at the 1% significance level, like Giacomini, Ling & Narjano (2015). However, compared to Asia Pacific M1, leverage is no longer significant. This contradicts Giacomini, Ling & Narjano (2015). In identifying a diversification discount effect, no significance for levdiv is found, thereby finding no support for the risk reduction hypothesis by Mansi & Reeb (2002) and Doukas & Kan (2006) for the Asia Pacific market.

Subsamples

The effects of different periods and diversification levels are investigated by using subsamples for comparison. All results can be found in appendix 4. Every period in table 5 is approximately between 7 to 10 years, which separates the dotcom from the financial crisis and the recovery period afterward. For example, period one is 1991-2001, period two is 2002-2009 and period three is 2010-2019.

The Fama French factors show mixed results where some factors are relevant in some periods and lose significance in other periods. For example, the MktRF factor is negatively significant at the 10% level in the first period but becomes positively significant at the 5% level in the second period. For the SMB factor, we see the same effect where SMB is positively significant at the 1% level for periods one and two but negatively significant at the 1% level for period three. HML is only found negatively significant for period two. The newly added factor RMW is negatively significant for period three. The other new factor CMA is positively significant at the 1% level for period two. Momentum is found to be negatively significant at the 5% level for period 1. Inflation shows different results per period as well. It is positively significant at the 1% level in period two. For period three, it is negatively significant at the 10% level.

When the effects of shorter periods are reported in the table, leverage and geographical diversification are no longer significant compared to the results of table 3. The significance of our interaction variable levdiv fades away and is no longer significant when allocating in smaller periods. Crisis is only found to be negatively significant at the 1% level for the second-period category. However, no evidence is found for the interaction between leverage and crisis on excess returns. When looking at financial constraints, logsize is found negatively significant for the first period at the 5% level. Financial freedom is only significant at the 5% level in the first period. The interaction between financial freedom and leverage Finlev is negatively significant at the 10% level for the second-and third-period category.

The second subsample table 6 of appendix 4 involves allocating into three groups based on the degree of diversification. Specialization involves all Herfindahl index values equal to 1 because all values lower than 1 involves diversification. Two categories have been developed to isolate diversification effects: low diversification and highly diversified. Results show that MktRF is negatively significant at the 1% significance level and SMB was positively significant at the 1% level for specialized firms. No other Fama French factor or momentum was found significant in any category. Leverage is found to be highly significant to the 1% level for specialized firms. Geographical diversification is also found to be highly significant to the 1% significance level for specialized firms.The interaction variable for leverage and geographical diversification levdiv is negatively significant at the highest level of 1%. This result is consistent with Mansi & Reeb (2002) that also found a negative significant coefficient. The effects of crisis periods remain negatively significant to the 1% level for specialized firms. When interacting crisis with leverage, no negative significance is found. This is contrary to Giacomini, Ling & Naranjo (2015) that found significance for the interaction of crisis and leverage. The interaction between financial freedom and leverage is negatively statistically significant at the 1% significance level. For low diversification, only SMB and the market factor are positively significant at 10%. For high diversification, financial freedom is found to be positively significant at 10%.

4.1 Robustness

The robustness is investigated by sub-sampling leverage into three categories compared to the panel regression results in table 3 because diversification serves as a function of leverage, according to Mansi & Reeb (2002) and Doukas & Kan (2006). Both papers investigated this function by comparing two samples: one all-equity and one levered sample. Similar results were achieved where the all-equity sample showed no presence of a diversification discount whereas the levered sample showed the presence. Mansi & Reeb (2002) described that as leverage levels increased the diversification discount increased as well.

Each category is based on a percentile, small leverage is 25^{th} percentile, medium leverage is $25\text{-}50^{th}$ percentile and high leverage is 75^{th} percentile. When looking at table 4, MktRF is negatively significant at the 10% level for small leverage and the 5% significance level for medium leverage. SMB is positively statistically significant for higher leverage at the 1% significance level and the 10% level for medium leverage. HML stays negatively significant at the 5% level, compared to the previous pooled model, indicating that when the factor increases, then excess returns decline. The profitability estimator RMW is statistically negative at the 1% level for medium leverage. The investment factor CMA remains consistent with earlier results and is positively statistically significant for high leverage at the 1% significance level. Momentum is no longer significant when allocating among leverage sub-groups.

Table 4 robustness check by sub-sampling the key independent variable leverage into three categories each based on percentiles.

VARIABLES	(1) small leverage	(2) medium leverage	(3) high leverage
MktRF t-1	-0.295*	-0.392**	0.0505
	(0.168)	(0.162)	(0.324)
SMB t-1	-0.0559	0.337*	1.865***
	(0.296)	(0.172)	(0.448)
HML t-1	0.312	0.0405	-1.909**
	(0.287)	(0.166)	(0.749)
RMW t-1	-0.172	-0.451***	0.259
	(0.247)	(0.159)	(0.399)
CMA t-1	-0.104	0.238	1.923***
	(0.299)	(0.224)	(0.715)
MOM t-1	-0.0145	0.117	-0.331
	(0.149)	(0.146)	(0.410)
financialfreedom t-1	0.240	0.154	-0.696

	(0.260)	(0.169)	(0.445)
inflation t-1	-0.216	1.122	3.170
	(1.736)	(1.616)	(5.225)
excessmarketfactor t-1	0.134	0.0677	-0.480*
	(0.154)	(0.142)	(0.284)
leverage t-1	0.614	2.012***	1.598*
	(1.822)	(0.740)	(0.957)
logsize t-1	-0.0112	-0.217**	-0.266
	(0.156)	(0.0934)	(0.250)
firmage t-1	0.887	-0.195	-0.814
	(0.667)	(0.338)	(0.848)
geodivers t-1	0.193	0.855**	0.0867
	(0.595)	(0.382)	(1.481)
Crisis	-0.183	-0.588***	-0.00710
	(0.138)	(0.140)	(0.260)
crisis_leverage t-1	-0.293	0.487*	-0.120
	(0.316)	(0.283)	(0.288)
levdiv t-1	-0.130	-1.574**	-1.973**
	(1.887)	(0.741)	(0.942)
firmconstraint t-1	-0.145	0.0109	0.148
	(0.131)	(0.0546)	(0.146)
finlev t-1	-0.416	-0.965***	0.337
	(0.370)	(0.264)	(0.280)
Constant	-0.0725	1.006*	1.923
	(0.872)	(0.563)	(2.112)
Observations	644	1,290	645
Adjusted R-squared	0.135	0.287	0.286
Firm FE	YES	YES	YES
Country FE	YES	YES	YES
year FE	YES	YES	YES

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Compared to the previous panel regression in table 2, inflation loses significance when allocating among leverage groups. The excess market factor is negatively statistically significant for the high leveraged group at the 10% level, implying that excess market returns move along with REIT excess returns. Leverage shows a positive relationship at the 1% significance level for medium leverage and a positive relationship at the 10% significance level. Crisis is negatively significant at the highest significance level of 1% for medium leverage. When interacting crisis with leverage, it shows positive significance at the 10% level compared to table 3 results for medium leverage.

When comparing the effects of geographical diversification, it remains consistent with the result of table 3. The coefficient sign of geographical diversification is positively significant at the 5% significance level. This implies that higher levels of specialization increase excess returns for medium leveraged REIT firms. The same effect on the interaction term levdiv is found. The magnitude changes but shows the same results. Medium- and high leverage REITs incur a negative diversification discount effect. Financial freedom loses significance, but the interaction term with leverage finlev is negatively significant for medium leverage at the 1% significance level. Therefore, this result remains consistent with the previous panel regression. Only log size is negatively significant for financial constraints at the 5 % significance level for medium leverage. To summarize, no significant inconsistencies are found compared to earlier findings in table 3.

5. Discussion

Developing international REIT markets and the increase in global debt sparks interest in mitigating risk across REIT firms. As a result, research about the mechanism between geographical diversification and leverage levels for REITs to diminish firm risk becomes more relevant. The regression framework in chapter 2.3 sets out a model that analyzesthe effect of the mechanism on REIT excess returns in identifying a negative diversification discount effect. The impact on REIT excess returns is tested by using an interaction variable between leverage and geographical diversification, as this procedure was done by Mansi & Reeb (2002) in identifying this effect. Specialized REITs are more exposed to higher market risk than diversified REITs (Ro & Ziobrowski, 2011). Therefore, it is expected that that the negative interaction effect is present for REITs that diversified as the risk premium decreases.

An expanded timeline is integrated to account for the effects of the multiple crises- and prosperous periods. In addition, more countries and REIT markets have been integrated, including 15 countries compared to the 8 countries in Giacomini, Ling & Naranjo (2015). As a result, the findings presented by this study decrease the literature gap on excess REIT returns. The model further expanded by combining Fama French factors, country- and firm characteristics regressed on REIT excess return. A model that can capture risk premium captured by the sum of systematic and idiosyncratic risk minus the risk-free rate, assists this research in identifying a negative diversification discount effect on REIT excess returns. A fixed-effect panel regression is utilized for this research.

Main results regarding the research aim depict that leverage has a positive relation with excess returns, indicating that leverage increases excess returns in the pooled, Asian and European groups. However, limited evidence is found for the negative effects of leverage during crisis years, contrary to Giacomini, Ling & Naranjo (2015). Diversified REITs could have an impact on the financial distress effect as a result of high leverage. Unlike the findings by Ambrose et al. (2000) and Gyrouko & Nelling (1996), evidence for higher return levels when a REIT is geographically specialized is present. This result could be caused by economies of scale or the lower information costs when entering new markets, as argued by Turnbull & Sirmans (1993). In crisis time, excess returns decrease, but this is not based on leverage levels as no significant interaction variable for crisis and leverage was found.

The finding for the interaction term levdiv illustrates that the typical relationship between excess returns, leverage, and geographical diversification hold. In addition, the analysis illustrates evidence that higher levels of leverage and geographical diversification decrease excess returns. Similar to the result for the interaction term from Mansi & Reeb (2002), this provides evidence that the mechanism diversification as a function of a firm's leverage lowers a REIT's excess return. Similarly, it confirms the risk-reduction hypotheses presented by Mansi & Reeb (2002), Lins &

Servaes (1999), Doukas & Kan (2006) and Kuppuswamy & Villalonga (2016) in identifying a negative diversification discount effect.

However, diversification is seen as a long-term effect as shorter period subsamples illustrate no diversification discount effect. Specialized REITs show a significant negative effect for levdiv, a positive effect for leverage and diversification. However, once REITs are diversified, this negative effect is no longer found significant. Furthermore, when firms are diversified, no significant positive effects from leverage or specialization are found on excess returns. This illustrates that diversification affects a firm's leverage and not the other way around, confirming Mansi & Reeb (2002) & Doukas & Kan (2006). In other words, diversified REITs cannot increase excess returns by increasing leverage. Only specialized firms show the positive significance for leverage and geographical specialization.

Robustness analysis for leverage levels provided a similar result. Low levels of leverage show no significance for levdiv. However, when checking medium- to high leverage levels, a significant negative result for levdiv is found. Like the main analysis, the results for leverage and geographical diversification as separate factors remain positively significant for medium- and high leverage levels.

These findings provide significant implications on geographical diversification based on the level of leverage for REITs. Instead of incurring the highest risk premium for its investors, thereby reaching high volatility, implementing geographical diversification can mitigate firm-specific risk. As a result, investors can use a diversified REIT as an accessible way to enjoy the benefits of diversification without portfolio building.

This study encounters several limitations. The first limitation is that this study can show geographical diversification through a measure such as the Herfindahl index. However, no inferences can be made regarding optimal diversification strategies for REITs because of the absence of holdings or transactional data. Another significant issue is data availability. Missing values for REIT returns on DataStream is a problem. Other databases that contain complete REIT information might solve the issue. Another limitation is the time notation of the variables. Some variables, such as financial freedom, are only available in annual data. This makes it hard to use monthly or quarterly data for other types of independent variables. Consequently, all data needed to be in annual form, or the model was not feasible.

Future research should investigate capital structures of REITs on domestic- and foreign assets on the performance of geographical segments. This research would focus on the optimal diversification strategies for REIT. However, firm-level data is needed as well as holdings data to conduct this type of research. Another contribution to the literature would be by expanding the current findings by adding property segment diversification and compare the results to geographical diversification. Other research topics could focus on investigating home bias among REITs, including performance worldwide and which countries or circumstances create home bias.

6. Conclusion

The mechanism between leverage and geographical diversification has an essential role in identifying a negative diversification discount effect. High leverage levels increase a firm's risk that can be diversified away, thereby lowering the risk premium in lower excess returns.

This paper analyzed whether this mechanism applies to REITs using 2579 REIT return observations over 15 countries from 1991-2019[1]. Our findings illustrate that further geographical specialization increases excess returns because of the additional firm-specific risk incurred. Leverage positively increases REIT excess returns focusing on the pooled group, Europe and Asian Pacific region. When interacting leverage with geographical diversification, we confirm a diversification discount effect in the form of a negative effect in REIT excess returns for the pooled- and European group. Robustness analysis confirms the presence of a diversification discount effect for medium- and higher leveraged REITs. This implies that a negative diversification effect on excess returns as a function of a REIT's leverage level is present. Further analysis on period subsamples shows no evidence of a negative diversification discount effect. For diversification level subsamples, firms that are specialized show a negative significant effect by this diversification discount. These results imply that REITs with high leverage levels could use geographical diversification to lower firm-specific risk. As a result, investors are exposed to lower risk enabling investors to enjoy diversification benefits without portfolio building.

[1] Data collection and issues regarding the unbalanced panel used in this research can be found in chapter 3 REIT data

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Appendices

Appendix 1 extended descriptives

tabulation of year and nation

	Australia	Belgium	Canada	France	Germany	Great Britain	Greece	Hong Kong	Ireland	Italy	Japan	New Zealand	Singapore	Spain	United States	Total
1992	1	0	0	2	1	5	0	0	0	0	0	0	0	0	10	19
1993	1	0	0	3	1	5	0	0	0	0	0	0	0	0	12	22
1994	1	0	0	3	1	5	0	0	0	0	0	0	0	0	14	24
1995	0	0	0	3	1	6	0	0	0	0	0	0	0	0	25	35
1996	0	0	0	3	1	6	0	0	0	0	0	0	0	0	38	48
1997	1	0	1	4	0	6	0	0	0	0	0	1	0	0	41	54
1998	2	0	2	5	0	6	0	0	0	0	0	1	0	0	41	57
1999	2	0	2	6	0	4	0	0	0	0	0	1	0	0	42	57
2000	2	0	1	4	0	4	0	0	0	0	0	1	0	0	45	57
2001	4	0	2	4	1	5	0	0	0	0	0	1	0	0	45	62
2002	4	0	5	3	0	5	0	0	0	0	0	0	0	0	46	63
2003	4	0	6	5	0	5	0	0	0	0	0	0	0	0	44	64
2004	5	0	7	4	0	5	0	0	0	0	0	1	0	0	45	67
2005	5	1	8	4	0	3	0	0	0	0	0	1	0	0	48	70
2006	5	1	8	3	2	4	0	0	0	0	0	1	0	0	53	77
2007	9	1	7	5	2	7	0	0	0	1	0	1	1	0	54	88
2008	10	1	8	5	2	7	0	1	0	1	0	1	5	0	53	94
2009	10	3	8	5	2	8	0	3	0	1	0	2	4	0	54	100
2010	8	5	8	7	2	8	1	3	0	1	1	1	4	0	54	103
2011	8	5	9	7	1	7	1	3	0	0	1	1	6	0	52	101
2012	9	5	11	8	2	9	1	3	0	0	1	2	7	0	57	115
2013	10	4	11	6	3	9	1	3	0	0	1	2	7	0	59	116
2014	10	4	14	4	4	11	2	4	0	0	8	2	10	0	60	133
2015	13	5	16	6	4	10	1	6	0	0	19	4	14	0	62	160
2016	16	5	15	6	4	11	1	6	1	1	22	4	17	2	64	175
2017	17	4	17	7	4	12	1	6	1	1	26	4	17	5	71	193
2018	19	6	16	8	4	14	1	6	1	1	29	4	19	7	74	209
2019	21	5	16	8	3	14	2	6	1	1	31	5	19	9	75	216
Total	197	55	198	138	45	201	12	50	4	8	139	41	130	23	1338	2579

tabulation of nation and industries covered

	commercial	diversified	industrial	lodging	residential	specialised	specialised	Total
Australia	52	100	19	17	7	2	0	197
Belgium	31	2	2	0	20	0	0	55
Canada	52	49	27	5	62	3	0	198
France	60	32	0	24	15	7	0	138
Germany	7	13	1	0	0	24	0	45
Great Britain	148	8	0	0	15	30	0	201
Greece	4	8	0	0	0	0	0	12
Hong Kong	0	29	0	21	0	0	0	50
Ireland	0	0	0	0	4	0	0	4
Italy	0	8	0	0	0	0	0	8
Japan	10	55	23	17	34	0	0	139
New Zealand	15	26	0	0	0	0	0	41
Singapore	67	5	17	10	12	19	0	130
Spain	13	4	0	0	6	0	0	23
United States	490	126	144	167	296	94	21	1338
Total	949	465	233	261	471	179	21	2579

tabulation of nation and geographical diversification

	diversified	specialized	Total
Australia	86	111	197
Belgium	15	40	55
Canada	72	126	198
France	50	88	138
Germany	19	26	45
Great Britain	61	140	201
Greece	4	8	12
Hong Kong	12	38	50
Ireland	0	4	4
Italy	0	8	8
Japan	0	139	139
New Zealand	0	41	41
Singapore	52	78	130
Spain	4	19	23
United States	227	1111	1338
Total	602	1977	2579

Appendix 2 diagnostics

In regression framework of chapter 2.4, multiple problems have been described as a result of the choice of the research method. The first step of getting more robust estimates and mitigate possible biases as a result.

The first formal test is whether the panel data regression has to be run in either fixed effects or random effects. The Hausman Test is suitable to make that determination. The Hausman test is standard in testing with to give a valid in going for fixed effects or random effects analysis, though Hoechle (2007) added that the estimates by the pooled OLS regression in the form of random effects might produce inconsistent, which is the null hypothesis of no inclusion of fixed effects. So rather than comparing the coefficients Hoechle (2007) recommends using the sigma.

Hausman (1978) specification test

	Coef.
Chi-square test value	*200.952*
P-value	*0.0000*

This result probability result is under the significance level of 1 percent. Therefore, we can reject the null hypothesis that random effects are likely to produce inconsistent coefficient estimates. Instead, this thesis used fixed effects in all panel regressions.

Since the Hausman test indicates that fixed effects were recommended, the next test would be in estimating whether the variance is homoskedastic or heteroskedastic. When applying a fixed model, it is assumed to be homoskedastic, but since cross-sectional time series is likely to behave in a heteroskedastic pattern, it needs to be diagnosed. The advantage of using this diagnostic for heteroskedasticity is that it changes its computation of the test statistic for unbalanced panel could be the case in cross-sectional time-series data.

Modified Wald test for groupwise heteroskedasticity in fixed effect regression model:

H0: sgima(i)^2= sigma^2 for all i

chi2(252) = 4.4e+34

Prob > chi2 = 0.0000

Heteroskedasticity is detected based on the test result. We, therefore, reject the null hypothesis of constant error variance. Robust standard errors will adjust the standard errors.

When testing for serial correlation, the Wooldridge test for autocorrelation has been applied, this test is made explicitly for macro panels with a long time frame and therefore perfect for identifying the first-order autocorrelation.

Wooldridge test for autocorrelation in panel data

H0: no first order autocorrelation

F(1, 213) = 209.239

Prob > F = 0.0000

Based on the result, we reject the null hypothesis and conclude that the first-order autocorrelation exists in our panel data, so clustered standard errors will be utilized.

To test whether a panel regression model with time-fixed effects can be used, it needs to test by investigating the null hypothesis of whether all the year dummies are equal to 0.

(1) 1993.year = 0

(2) 1994.year = 0

(3) 1995.year = 0

(4) 1996.year = 0

(5) 1997.year = 0

(6) 1998.year = 0

(7) 1999.year = 0

(8) 2000.year = 0

(9) 2001.year = 0

(10) 2002.year = 0

(11) 2003.year = 0

(12) 2004.year = 0

(13) 2005.year = 0

(14) 2006.year = 0

(15) 2007.year = 0

(16) 2008.year = 0

(17) 2010.year = 0

(18) 2011.year = 0

(19) 2012.year = 0

(20) 2013.year = 0

(21) 2014.year = 0

(22) 2015.year = 0

(23) 2016.year = 0

(24) 2017.year = 0

(25) 2018.year = 0

(26) 2019.year = 0

F(26, 2282) = 20.94

Prob > F = 0.0000

Though the probability is highly significant and, therefore, we reject the null hypothesis. All panel regressions should include time fixed-effects.

Appendix 3 selection of factors

Based on the description of the Fama French factors in chapter 2.1, this chapter motivates the selection of other relevant factors in the regression framework in formula (6) of chapter 2.4. There is some criticism regarding the Fama French five-factor model, especially for lacking a momentum factor (Blitz & Hanauer, 2018).

Reit Momentum, which affects REIT performance, is missing, according by Derwall et al. (2009). Momentum is a dominant predictor for REIT firm returns during the post-1990 period (Chui et al., 2003). When testing the explanatory model of existing models and adding factors, Buttimer Jr., Cheng & Chaing (2012) found that including additional risk factors significantly increased the explanatory power of the models.

Adding international real estate securities in a mixed portfolio for a U.S. investor offers significant risk-reducing diversification benefits (Gordon et al., 1998). However, every country has its structure in politics, markets and legal systems that affect REITs. REIT return results indicate substantial variation in returns per country caused by excess systematic risks embedded (Ling & Naranjo, 2002). Brounen & Koning (2012) showed that REITs could produce a higher abnormal return than the stock market, though the effect varies per country. With the integration of REIT markets, markets respond differently to macroeconomic variables. As an example, Asian REITs are more sensitive to changes in macro-economic environments compared to developed REIT markets (Loo et al., 2016).

Consequently, investors are seeking a hedge against inflation since it decreases returns. Real return has a negative relationship with both anticipated and unanticipated inflation (Bodie, 1976). Findings by Park, Mullineaux & Chew (1990) imply that because REITs behave like stocks, it is a partial hedge against anticipated inflation. In addition, there is evidence that inflation hedges are not present for U.S. REITs. However, Gyourko & Linneman (1988) investigated real estate correlations and found that REITs are strongly negatively correlated to inflation.

The local market factor is also important in capturing the continental co-movement of the home country and the other markets (Eichholtz et al., 1998). Investment in foreign real estate is determined by highly developed capital markets, investor protection, administrative burdens, regulatory power and the political/socio-cultural environment (Mauck & Price, 2017). The openness of a country is negatively related to excess returns. Therefore, further markets integration would result in more efficient markets that decrease information opaque and risk premiums (Bardhan et al., 2008).

Spreading risks incentivizes firms to go overseas (Hisey & Caves, 1985). The valuation effect of diversification differs because of international differences in a firm's corporate governance (Lins & Servaes, 1999). The paper mentions that diversification reduces risk. Therefore, the shareholder value results in a reduction in value and an increase in value for bondholders. When measuring the effect of diversification and leverage as an interaction variable, the coefficient is negatively significant and shows that the value of a firm goes down when increasing leverage (Mansi & Reeb, 2002). This result is also consistent with Doukas & Kan (2006).

On the opposite of diversification benefits, there is an argument by Ambrose et al. (2000) that economies of scale is reached by REIT firms that are geographically concentrated. However, Ambrose et al. (2000) nor Gyourko & Nelling (1996) found evidence for economies of scale by geographical specialization. Both papers use a measure for geographical diversification in the form of the Herfindahl index, which measures the asset weights of the total portfolio.

Two theoretical concepts for firms' diversification during the financial crisis are given by Kuppuswamy & Villalonga (2016). The authors compared the discount of diversification by applying interactions through OLS regressions in pre, during and post-crisis periods by using treatment groups. Diversification is not quantified in this paper. Instead, it is used as a dummy variable and counts for industries rather than regions. In addition, the internal firm financial constraints have not been taken into consideration, only external financial constraints.

The first theory to justify the relationship is that firms can use diversification as a way of debt coinsurance or the role of internal capital markets during financial crises. Debt coinsurance refers to that diversified firms take more leverage than focused firms in the same industry. The results of the paper of Kuppuswamy & Villalonga (2016) confirm this hypothesis.

The second theoretical concept presented by Kuppuswamy & Villalonga (2016) is that internal capital markets are more efficient during crisis periods. Leverage has a role in allocating capital to investments that generate cash flow levels to meet the company's debt obligations (Peyer & Shivdasani, 2001). Consequently, firms focus on internal resources when external credit is constrained. Constraining credit would incentivize a firm to allocate its scarce resources to the best projects. This makes diversification during crisis periods more valuable.

During the great financial crisis, constrained firms tend to cut deeper in their spending and use more lines of credit from constrained banks in fear of credit restriction. As a result, firms are more likely to miss good investment opportunities (Campello et al., 2010). Consequently, financial constraints and liquidity remain important for REITs. Firms with less financially constrained firms are experiencing lower investment levels (Riddiough & Wu, 2009).

The dependence on cash flow for investments is the highest for externally financially constrained firms and high internal funds. When firms are financially constrained and highly leveraged, capital allocation becomes more critical for these firms and makes suitable investments difficult (Guariglia, 2008).

The paper by Giacomini, Ling & Naranjo (2015) found limited evidence to support the role of financing constraints in explaining REIT returns variations. The paper uses a KZ index to estimate constraints. Though, this measure has been criticized for its validity by Hadlock and Pierce (2010). The authors propose a measure that relies only on firm characteristics. Instead, firm size and age can predict financial constraints instead of the KZ index. Conover et al. (1998) found that the greater firm size, the higher the return and the lower the risk. Fink et al. (2006) explain that age characteristics cause firms' idiosyncratic risk because of increased risks for younger companies.

Another variable that measures external financial constraints could be proxied by a country score in financial freedom because banks offer an essential role for capital access. Financial freedom assesses banking efficiency in a country over time. The score is based on government involvement in the banking sector in the form of ownership, the development of the financial market, degree of regulation and market openness to foreign competition (The Heritage Foundation, n.d.). This measure has been used earlier by Chortareas et al. (2013) to investigate the link between financial freedom and banking efficiency.

Appendix 4 subsamples

The effects of shorter periods are investigated by sub-sampling 29 years into three separate categories in table 5 compared to table 3 in the analysis section. Each category is based on a crisis and recovery periods. The first category, 1991-2001, involves a booming period in the '90s and the dot-com crisis. The second category involves the Dot-com recovery till the great financial crisis from 2002-2009. Finally, the third category encompasses the recovery period after the great financial crisis from 2010-2019.

Table 5 panel regression based on periods

VARIABLES	(1) 1991-2001	(2) 2002-2009	(3) 2010-2019
MktRF t-1	-0.519*	0.752**	0.114
	(0.281)	(0.352)	(0.113)
SMB t-1	1.016***	1.894***	-0.354***
	(0.268)	(0.611)	(0.135)
HML t-1	-0.497	-1.135**	-0.0186
	(0.373)	(0.489)	(0.204)
RMW t-1	0.0588	0.839	-0.499**
	(0.344)	(0.565)	(0.202)
CMA t-1	0.159	2.299***	0.0532
	(0.375)	(0.676)	(0.228)
MOM t-1	-0.483**	-0.501	0.267
	(0.203)	(0.322)	(0.163)
financialfreedom t-1	-1.031**	-0.0326	0.436
	(0.423)	(0.508)	(0.289)
inflation t-1	1.939	13.52***	-1.800*
	(2.569)	(4.880)	(0.964)
excessmarketfactor t-1	0.534	-0.712***	0.321***
	(0.356)	(0.270)	(0.100)
leverage t-1	2.699	-0.143	1.217
	(3.068)	(2.204)	(0.796)
logsize t-1	-0.398**	-0.141	-0.0235
	(0.188)	(0.241)	(0.104)
firmage t-1	-0.929	-0.176	0.178
	(0.651)	(0.555)	(0.416)
geodivers t-1	0.972	0.368	0.275
	(1.487)	(1.195)	(0.312)
Crisis	0.0569	-0.574***	

	(0.128)	(0.122)	
crisis_leverage t-1	-0.00149	-0.0959	
	(0.114)	(0.168)	
levdiv t-1	-2.527	0.463	-1.071
	(3.063)	(2.229)	(0.766)
firmconstraint t-1	0.203	0.0948	-0.0168
	(0.124)	(0.124)	(0.0639)
finlev t-1	-0.165	-0.420*	-0.397*
	(0.272)	(0.244)	(0.223)
Constant	1.875	0.0622	-0.227
	(1.925)	(1.537)	(0.775)
Observations	498	560	1,521
Adjusted R-squared	0,307	0,445	0,161
Firm FE	YES	YES	YES
Country FE	YES	YES	YES
year FE	YES	YES	YES

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The effects of diversification are investigated by sub-sampling. Different levels of diversification are given in table 6 to compare with table 3 in the analysis section. The first category specialization includes all observations where the value of the Herfindahl index is equal to 1 that involves that all investments are made in one geographical segment. The second category of low diversification involves all values greater than 0.5 and lower than 1. Finally, the third category, highly diversified, encompasses all values lower than 0.5.

Table 6 panel regression based on the degree of diversification.

	(1)	(2)	(3)
VARIABLES	specialised	Low diversification	Highly diversified
MktRF t-1	-0.383***	-0.360	-0.402
	(0.140)	(0.420)	(0.476)
SMB t-1	0.560***	1.041*	0.889
	(0.136)	(0.616)	(0.700)
HML t-1	-0.0657	0.636	0.0708
	(0.190)	(0.613)	(1.036)
RMW t-1	-0.154	0.108	0.0778
	(0.144)	(0.636)	(0.972)

CMA t-1	0.287	0.00453	-0.234
	(0.201)	(0.653)	(0.926)
MOM t-1	0.114	-0.00916	-0.952
	(0.113)	(0.282)	(0.672)
financialfreedom t-1	-0.105	-0.403	1.607*
	(0.189)	(0.762)	(0.810)
inflation t-1	-1.454	6.542	5.846
	(1.114)	(6.110)	(4.769)
excessmarketfactor t-1	-0.0557	0.513*	-0.169
	(0.125)	(0.272)	(0.423)
leverage t-1	7.073***	1.368	2.842
	(1.851)	(1.464)	(1.790)
logsize t-1	-0.0526	-0.206	-0.296
	(0.0958)	(0.576)	(0.573)
firmage t-1	-0.0287	1.117	0.00268
	(0.331)	(2.705)	(4.978)
geodivers t-1	4.089***	0.648	0.773
	(0.964)	(0.773)	(0.998)
Crisis	-0.213***	-0.777	-0.690
	(0.0563)	(0.496)	(0.418)
crisis_leverage t-1	-0.0316	-0.349	-0.550
	(0.0796)	(0.726)	(0.637)
levdiv t-1	-6.898***	-1.288	-1.939
	(1.849)	(2.112)	(2.636)
firmconstraint t-1	-0.00325	-0.156	-0.186
	(0.0587)	(0.459)	(0.668)
finlev t-1	-0.391***	0.103	-2.095
	(0.144)	(0.627)	(1.531)
Constant	-3.316***	1.236	2.275
	(1.136)	(3.868)	(4.004)
Observations	2,274	187	118
Adjusted R-squared	0.193	0.327	0.356
Firm FE	YES	YES	YES
Country FE	YES	YES	YES
year FE	YES	YES	YES

Clustered standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1