The influence of leverage on the risk-return profile of listed real estate

Rob Sukaldi*

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Abstract

This paper examined the effect of leverage on excess returns in the real estate sector. Using quarterly data from Q4 2002 till Q2 2017 and a worldwide sample of listed real estate investment trusts (REITs) from various sectors, this paper is able to analyze sector and country differences in excess returns. By dividing REITs into leverage groups based on their quarterly leverage this paper concludes that leverage contributes negatively to excess returns in two out of ten leverage groups, while its effect is insignificant in the other leverage groups. Excess returns are the highest for REITs with a leverage ratio between 41.02% and 45.75%. Although the leverage effect is significantly negative for REITs with leverage up to 27.1%, the Sharpe ratio for this group exceeds the Sharpe ratio for the leverage group with the highest average return.

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* University of Groningen, Faculty of Economics and Business, Duisenberg Building, Nettelbosje 2, 9747 AE Groningen, r.sukaldi@student.rug.nl. The author would like to thank R. Klijnstra and M. van Son for their knowledge and guidance.

1. Introduction

Risk-averse investors consider real estate as an interesting investment due to its characteristics as stable rent income and long-term constant value (Hartzell, Hekman, and Miles, 1986; Imperiale, 2006). Furthermore, listed real estate exhibits resemblances with equity, but it also provides diversification possibilities making it an attractive investment category (Newell and Keng, 2006; Morawski, Rehkugler, and Fss, 2008; Adair, Berry, and McGreal, 1994; Feldman, 2003; van Loon and Aalbers, 2017). Real estate as a diversification possibility makes it thus a more suitable investment for investors with risk-averse preferences (Lee and Stevenson, 2006).

Morawski et al. (2008) state that listed real estate provides a higher return than non-listed real estate, since non-listed real estate is generally characterized with high transaction cost, illiquidity and a low degree of information efficiency. Apart from higher returns, especially in the short-run, listed real estate shows a higher volatility compared tot non-listed real estate, due to the imperfect marketability of non-listed real estate (Fuerst and Matysiak, 2013). Higher volatility in absolute terms is supposedly caused by the high leverage of listed real estate, since, according to the financial theory, leverage adds risk to an investment due to financial risk and the increased risk of bankruptcy (Newell and Keng, 2006; Mandelker and Rhee, 1984; Morawski et al., 2008). To what extent leverage alone explains the additional volatility is still insufficiently understood (Alcock, Baum, Colley, and Steiner, 2013).

Regarding the influence of leverage on return Modigliani and Miller (1958) state that leverage directly influences the riskiness of the cash flows to equity, thus raising the required rate of return on equity. This positive relationship between leverage and return is debated in financial literature. While Bhandari (1988) and Fama and French (1992) find a positive relation between leverage and return, others find a negative relationship (Penman, Richardson, and Tuna, 2007; Dimitrov and Jain, 2008; George and Hwang, 2010). Giacomini, Ling, and Naranjo (2014) acknowledge the relevance of leverage in real estate and state that research on this particular topic is lagging compared to other factors. Related to real estate, the results of Giacomini, Ling, and Naranjo (2016) show that highly levered real estate investment trusts (REITs), relative to the average REIT perform worse than REITs with low leverage in a years time. Even more so, REITs with lower leverage have a higher average return and a lower variance.

Investors investing in real estate do so because of the characteristics of real estate. Influences of leverage might be unwanted, since this is not necessarily a characteristic of real estate. In light of the aforementioned studies, it is clear that research has not reached any kind of consensus as to what factors can consistently explain most of the cross-sectional

return variations among REITs.

Since studies on the influence of leverage on real estate returns are limited and provide conflictive evidence, this paper extends the work of Cheng and Roulac (2007); Giacomini et al. (2014) and examines whether leverage influences REIT returns, and subsequently if it is possible to form a portfolio of listed real estate funds with a low degree of leverage which has a return similar to that of listed real estate funds with high leverage. In doing so, this paper extends the limited body of existing literature on the influence of leverage in REITs and provides practitioners with information on the risk and return relationship in REITs, as this thesis is the result from a thesis internship at a finance consultancy firm.

The remainder of this paper is organized as follows: in the next chapter the literature will be discussed, followed by, respectively, the methodology and data analysis in chapter 3 and 4. The results of the analyses in this paper can be found in chapter 5 and are discussed in full in the conclusion.

2. Literature review

Hartzell et al. (1986) state that the, at the time, recent movement towards real estate arose due to an increased awareness of market opportunities. Hartzell et al. (1986) give two explanations; firstly, the expected returns of real estate might have been mispriced relative to those of stocks and bonds. Secondly, real estate might offer unexploited diversification opportunities due to low or negative covariance of the expected returns with the investors' existing portfolios. If the first explanation could be true, it surely does not hold in the long-run due to the arbitrage pricing theory of Ross (1976). The second explanation seems more reasonable since current portfolio managers still hold real estate in their portfolio for, amongst others, diversification of their protfolio over different asset classes (Stevenson, 2000; Kuhle, 1987; Barry, Rodriguez, and Lipscomb, 1996; Goetzmann and Ibbotson, 1990).

According to Seiler, Webb, and Myer (1999) institutional investors, and others, invest in two ways in real estate; either via direct, or indirect investments. Direct real estate is obtained by directly buying the tangible asset. It is characterized by illiquidity, heterogeneity, and is uncorrelated with other assets classes (Eichholtz and Hartzell, 1996; Quan and Titman, 1997; Hoesli, Lekander, and Witkiewicz, 2004). In addition, direct real estate has good inflation hedging characteristics (Fama and Schwert, 1977; Hartzell, Hekman, and Miles, 1987; Hoesli, Lizieri, and MacGregor, 2007). Indirect real estate refers to investments via property pools, which are either listed or non-listed. Of particular interest for this paper are listed property pools, more specifically, REITs. Listed real estate constitutes homogeneous, liquid, and diversified investments with low transaction costs whose value should follow the

underlying real estate market in the long-run (Serrano and Hoesli, 2009). However, this might not always be the case, see for example Black Monday 1987 when the prices of REITs dropped by 20%, which exceeded the decline of the underlying real estate. This leads to arbitrage opportunities if the REIT value decreases below the underlying real estate. Since in that case one can buy the underlying real estate for the price of the REIT.

2.1. REIT background

REITs were created in 1960 by U.S. Congress to provide investors with the opportunity of investing in real estate and to obtain the benefits of regular shareholders (Chan, Erickson, and Wang, 2003). Prior to 1960 one could solely invest in real estate by purchasing the real estate directly. Nowadays, various forms of REITs exist (NAREIT, 2017). The most relevant distinction between REITs with respect to this paper is on the listed/non-listed axis. Three main forms of listed REITs exist; equity REITs which invest directly in the property, whereas mortgage REITs generate revenue through the interest being paid on the mortgage loans, and hybrid REITs which are a combination of both equity and mortgage REITs. This paper focuses on equity REITs since it examines the riskiness of the underlying and not the risk of the loan.[1] A further distinction between REITs can be made by the sector they operate in. The most common property types are: office, industrial, retail, lodging, residential, timberland, health care, self-storage, infrastructure, data centre, diversified, and specialty.

2.2. REIT characteristics

Since the proliferation of real estate at the beginning of the 21$^{\text{th}}$ century, the global real estate industry has been transformed (Serrano and Hoesli, 2009); various organizational, operational, distribution and compliance requirements comply to entities in order to qualify as a REIT. Although U.S. REIT sets the standard, each country creates own regulation. The REIT structures offer firms the ability to avoid taxation at the entity level in exchange for restrictions on dividend payout ratios, capital structure, share ownership, and the types of investment activities in which the REIT can engage. There is, however, variation in these restrictions across countries. The National Association Real Estate Investment Trusts (NAREIT), a U.S. based representative for REITs, states that to qualify as a REIT; an entity must be a board managed, taxable company with a minimum of 100 shareholders, of which five cannot hold more than 50% of total shares, it must invest at least 75% of its total assets in real estate, derive 75% or more of its gross income from rents from real estate

[1]For a detailed description on REITs see (Chan et al., 2003).

and pay at least 90% of its yearly taxable income as dividends. Since the dividend payment of REITs is tax deductible, most REITs pay 100% of their taxable income as dividends to avoid corporate taxes thereby maximizing shareholder value (Geltner, Miller, Clayton, and Eichholtz, 2006).

In the US, Australia, and the Netherlands, a REIT is allowed to engage in property development for its own investment portfolio, provided development activities are carried out in a separate taxable subsidiary. In other countries development is not allowed; in France, it must not account for more than 20% of the value of total assets. Finally, a SICAFI in Belgium may develop real estate, provided it retains completed developments in their portfolio for at least five years. Many countries also limit the ability of REITs to dispose of properties; the intent of these restrictions is to require REITs to be long-term property investors, not active traders (Giacomini et al., 2014).

The paper of Serrano and Hoesli (2009) describes the differences between various real estate indexes and observes regarding leverage that it is restrained in 25 of the 31 countries they examined; leverage ratios range from 20% in Bulgaria to twice the equity value in South Korea. Cross-country differences in the effects of leverage on returns and volatility may be related, in part, to differences in allowable leverage limits across countries. In Canada, Australia, France, Spain, Italy, Turkey, and the USA, no legislative or statutory limits are placed on firm leverage. Leverage might be limited to 60% of fixed assets plus 20% of the value of other assets in Italy depending on the legal entity of the REIT. However, investors may punish a firms stock price if they believe the REIT's leverage exceeds acceptable levels. This market discipline may produce tighter effective limits on leverage than are dictated by legislation. In Belgium, the outstanding debt of REITs cannot exceed 65% of total asset value, whereas the maximum debt financing for German REITs (G-REIT) is 60% of the asset value. The maximum permitted leverage in the Netherlands and Italy equals the sum of 20% of non-real estate assets and 60% of real estate investments, based on the book value of the assets. Finally, in Singapore a REITs maximum leverage is generally 35% of the estimated market value of the firms assets. However, leverage of up to 60% is allowed provided the REIT discloses a credit rating from a major rating agency. In Malaysia REITs indebtedness cannot be more than 50% of the asset value. However, the leverage ratio might be increased by an ordinary shareholder resolution. Apart from regulation, leverage is expected to vary based on the sector a REIT is operating in since sectors as health care are less marketable than offices or residential properties. These notions on leverage are of importance since it shows that a wide variety of leverage exists, which according to financial theory influences the return performance.

2.3. Leverage and return

Literature on leverage and the influence on REIT returns is contradicting as was outlined in previous chapters. Where theory of Modigliani and Miller (1958) posits a positive relationship between leverage and return for equities, literature on leverage in real estate, specifically REITs, is contradictory. Bhandari (1988); Fama and French (1992) find a positive relation in equities. However, it is important to note that both studies use the market capitalization for leverage calculations, so there can be a joint effect of the book to market ratio and leverage on return. In contrast, Korteweg (2004) finds by the use of similar asset base betas, evidence of a negative relationship between leverage and return. However, the study of Korteweg (2004) is based on a small sample of 183 firms over a period clustered in the 1980s. A related study of George and Hwang (2007) continues on this notion and states that highly levered companies tend to show lower returns due to their asset base risk levels. The UK based study of Sivaprasad, Muradoglu, Gough, and Adami (2010) finds, using the Carhart four factor model, that highly levered firms yield significantly lower returns. Their leverage measure is however based on market values leaving results debatable.

While the aforementioned studies examine a linear relationship between leverage (being in book or market values) and return, Garlappi, Shu, and Yan (2008) find that the relationship between abnormal returns and leverage is not linear but concave. Returns should increase, according to Garlappi et al. (2008) up to the point where the default risk is that high that debt holders have a better negotiation position, leading to a lower return.

Results for the real estate sector stem from research of Yong, Allen, and Lim (2009) who examine the Australian REIT market by a multifactor linear regression over three time periods. Their results show a significant positive leverage effect on returns in one of the three examined time frames of the Australian REITs. Cheng and Roulac (2007) perform a similar study on U.S. REITs. They use five firm specific factors for two periods, and find a weak, but significant effect of leverage on returns.

A more recent study of Giacomini et al. (2014) uses international data of 400 REITs to examine the relationship between leverage and returns. Without the default risk, they find that leverage increases returns in up- and down markets. Including the default risk by means of the indicator of Kaplan and Zingales (1997) the evidence is less strong. Additionally, they find that the greater the use of leverage during the 2007-2008 crisis, the larger the share price decline. Giacomini et al. (2016) compare the leverage ratio of 341 U.S. REITs with their target leverage ratio and conclude that REITs that are overlevered (compared to their target leverage) underperform REITs with a lower leverage ratio. However, adjusting for risk, overlevered REITs to their target leverage ratio outperform unlevered REITs. Thus, Giacomini et al. (2016) conclude that leverage contributes significantly positive to return.

2.4. Trade-off theory

Since the interest on debt is deductible from taxable income, debt enhances returns. Furthermore, debt can reduce agency costs of the free cash flows (Jensen, 1986). A firm might thus have the highest amount as possible to minimize taxes, and maximize value. However, with the issuance of more and more debt, the financial distress costs rise. At a certain point these costs will offset the tax benefits and thus reduce returns (Shyam-Sunder and Myers, 1999). Related to the riskiness of the cash flows and the actual return, Sharpe (1964) developed the Sharpe ratio given by:

$$S = \frac{(\bar{R}_p - R_f)}{\sigma_p} \tag{1}$$

which gives the average expected return of the portfolio, $\bar{R}_p$, in excess of the risk free rate, R_f, per unit of risk measured by the standard deviation of the portfolio, σ_p.

3. Methodology

The analysis consists of two approaches. As a first step a sorts analysis will be performed to examine REITs as a whole and to examine differences between countries and sectors. Secondly, the leverage level of REITs will be used to try and explain REIT returns by using the Carhart (1997) four factor model.

According to classical financial theory of Modigliani and Miller (1958) adding debt leads to tax benefits and at a certain point to higher risk of bankruptcy, and thus it would be expected that there is no linear relationship between leverage and return. Furthermore, theory developed by Sharpe (1964) states that investors only care about risk and return which validates the methodology of looking at leverage and the influence on volatility and return from an investor perspective. Since literature on the influence of leverage in the REIT sector is inconclusive the first proposition examined in this paper is:

Proposition 1. *Leverage has no impact on return.*

This proposition will be tested by using an adjusted version of the Carhart (1997) four factor model. Carhart (1997) bases his research on Fama and French (1993, 1996) who examine the expected excess returns based on the excess market return, size, and book to market factors. The sample is split evenly into ten leverage groups, based on the quarterly leverage ratio, to examine the leverage effect while controlling for Fama and French (1996) factors and Carhart (1997) momentum factor. The regression results are thus obtained by the Carhart (1997) four factor model:

$$R_{i,t} - RF_t = \beta_0 + \beta_1(MKT_t - RF_t) + \beta_2(SMB_t) + \beta_3(HML_t) + \beta_4(MOM_t) + u_{i,t} \quad (2)$$

Where $R_{i,t}$ is the levered REIT i return at time t. β_0 is a constant term, $(MKt_t - RF_t)$ measures the quarterly excess return on the market over the risk-free rate, SMB_t and HML_t respectively represent Fama and French (1993) "Small Minus Big" and "High Minus Low" factors at time t. MOM_t represents the Carhart (1997) momentum factor. $u_{i,t}$ represents the error term. In line with Fama and French (1993) the risk-free rate, RF, at time t is represented by the 1-month US T-bill, and obtained from the Federal Reserve.[2]

Since asset classes exhibit different behaviors and Fama and French (1993, 1996) base their analysis on equities, whereas this paper examines the REIT asset class, the Fama and French (1993, 1996) factors might not fit properly if obtained from Kenneth French's website. Therefore, the Fama and French (1996) portfolios are created based on the REIT sample following the Fama and French (1996) methodology, the difference is however that while Fama and French (1996) base use the NASDAQ as reference, while this paper uses the total sample as a reference.

The Fama and French (1993) SMB and HML portfolio are based on size groups and book to market groups. Size consists of two groups; small and big. REIT i is categorized as small at date t if the market capitalization of REIT i at date t is lower than the median annual market capitalization of all REITs at date t. If the market capitalization of REIT i exceeds the median annual market capitalization at date t the REIT is classified as big. Secondly, REITs are grouped in a low, medium, or high book to market group based on the book to market value of the equity. The low group contains the REITs with 30% lowest book to market ratio REITs, the medium group contains the middle 40%, and a high group consisting of the 30% REITs with the highest book to market ratio at date t. The momentum portfolio is based on two size groups: based on the annual market capitalization REITs are classified as either small or big depending on the median annual market capitalization of all REITs in the sample at time t. Furthermore, the momentum portfolio is divided along the annual return axis with the same sorting criteria as the book to market groups. Implying that REITs with an annual cumulative return which belongs to the bottom 30% at time t as classified as losers, while REITs with an annual cumulative return which belongs to the middle 40% at time t belong to the medium group, and the REITs with the 30% highest annual cumulative returns form the winner group. All three portfolios are rebalanced on a yearly basis. The returns based on size, book to market, and momentum groups are calculated as the value weighted return, depending on the market capitalization of every REIT at time t. $(MKt_t - RF_t)$ is

[2]https://fred.stlouisfed.org/series/DGS1MO accessed at November 26$^{\text{th}}$, 2017.

constructed using the equally weighted individual quarterly REIT return minus the risk-free rate at time t. In line with Carhart (1997) the momentum factor is calculated as:

$$MOM_t = \frac{1}{2}(\text{small high}_t + \text{big high}_t) - \frac{1}{2}(\text{small low}_t + \text{big low}_t) \tag{3}$$

where small high means the return on the portfolio of small REITs with a high book to market ratio. The same reasoning goes for big high, small low, and big low.

Furthermore, based on the results from earlier studies, and varying regulation across countries, leverage is expected to vary widely across countries, and sectors, leading to the following propositions:

Proposition 2. *Excess returns are similar for all countries.*

Proposition 3. *Excess returns are similar for all sectors.*

Both hypotheses will be tested separately by extending formula 2 with respectively a country variable and a sector variable. Leading to, for proposition 2:

$$\begin{aligned} R_{i,t} - RF_t = \beta_0 + \beta_1(MKT_t - RF_t) + \beta_2(SMB_t) \\ + \beta_3(HML_t) + \beta_4(MOM_t) + \beta_5 Country_i + u_{i,t} \end{aligned} \tag{4}$$

and for proposition 3:

$$\begin{aligned} R_{i,t} - RF_t = \beta_0 + \beta_1(MKT_t - RF_t) + \beta_2(SMB_t) \\ + \beta_3(HML_t) + \beta_4(MOM_t) + \beta_5 Sector_i + u_{i,t} \end{aligned} \tag{5}$$

4. Data

4.1. Data selection

All REIT data is obtained from the SNL Database. Since SNL updates the constituents of the SNL Global REIT index on a quarterly basis, all (historical, as of Q4 2002) constituents enlisted on the SNL Global REIT index until Q2 2017 are obtained, leading to a total of 617 REITs that were or are listed. This leads to a total of 59 quarterly observations per REIT, and is the longest time period available for this index. The SNL Global REIT index includes all SNL REITs irregardless of total market capitalization or other criteria.

From the initial sample of 617 REITs, REITs that report quarterly information in US Dollars are included. REITs that report in regional currencies, not being US Dollars, are excluded for comparison reasons, these selection criteria lead to a sample of 387 REITs.

REITs with less than four consecutive values for either assets, equity, market capitalization or return are excluded from the sample. For REITs with one incidental date having a missing value for either total assets, debt or return the date entry is excluded from the analysis. This selection leads to a sample of 352 unique REITs. In line with Giacomini et al. (2014), this analysis is restricted to countries that have sufficient REITs over the sample period to conduct country- and sector-level analysis. Therefore, countries with less than three REITs are excluded from the country analysis, leading to a total of 341 REITs. Delisted REITs are included to resolve a possible survivorship bias.

The reason for using book values for the leverage ratio lies the in fact that otherwise two effects, the book to market ratio and leverage, would have a joint effect on realized returns. This combined effect arises if the market value of the assets would be used for calculating the leverage ratio. In the case that the market value of the assets would increase, this leads to a decrease in the book to market ratio, and lead to a lower leverage ratio since debt would remain constant while assets increase. This would be troublesome in the second part of the analysis. Debt is preferred over total liabilities since the latter includes minority interest and other non-core obligations which do not concern the core business of the REIT.

Dividends and stock splits are accounted for in the total return series of the SNL REITs. The REIT total return series is obtained as an index with a base of 100% at the IPO date. Therefore, the return series is transformed as to ensure that changes in return reflect percentage changes. The percentage return is given by:

$$R_{i,t} = \frac{I_{i,t} - I_{i,t-1}}{I_{i,t-1}} \tag{6}$$

Where $I_{i,t}$ is the indexed return value of REIT i at time t.

4.2. Data analysis

Based on a sample size of 341 REITs, table 1 provides descriptive statistics for the average REIT. From this, one can see that the average REIT has an asset base of 3.3 billion US$ and debt accounting for 48.72% of that on average. Bradley, Jarrell, and Kim (1984) examine 25 different industries and find an average leverage ratio of 29.13%. Moreira (2017) provides similar results with an average leverage ratio of 29%. This implies that REITs are on average heavily leveraged compared to other industries, as can be expected due to the tax advantage and relatively certain income stream. In addition, table 1 shows that albeit the standard deviation of leverage is relatively small, there are REITs with more debt than assets, and REITs without any debt. Both are remarkable; having more debt than assets implies negative equity, which in turn implies that the shareholder has to increase

his contribution. Since shareholders are not obligated to do so, REITs can eventually go bankrupt. Persistence of negative equity thus sends a signal to (potential) investors. A low leverage ratio is less drastic, but shareholder value could be increased by optimally using the the tax shield that arises from additional debt.

Table 1: Descriptive statistics per REIT

All values depict the averages per REIT over the whole analyzed period. Values for assets (*Assets*), debt (*Debt*), and equity (*Equity*) are reported in book values in thousand US$. Market capitalization (*MarketCap*) is the market value of the equity reported in thousand US$. Leverage (*Leverage*) is reported in percentages where 1 implies 100%, whereas the return (*Return*) is reported in percentages where 1 means 1%.

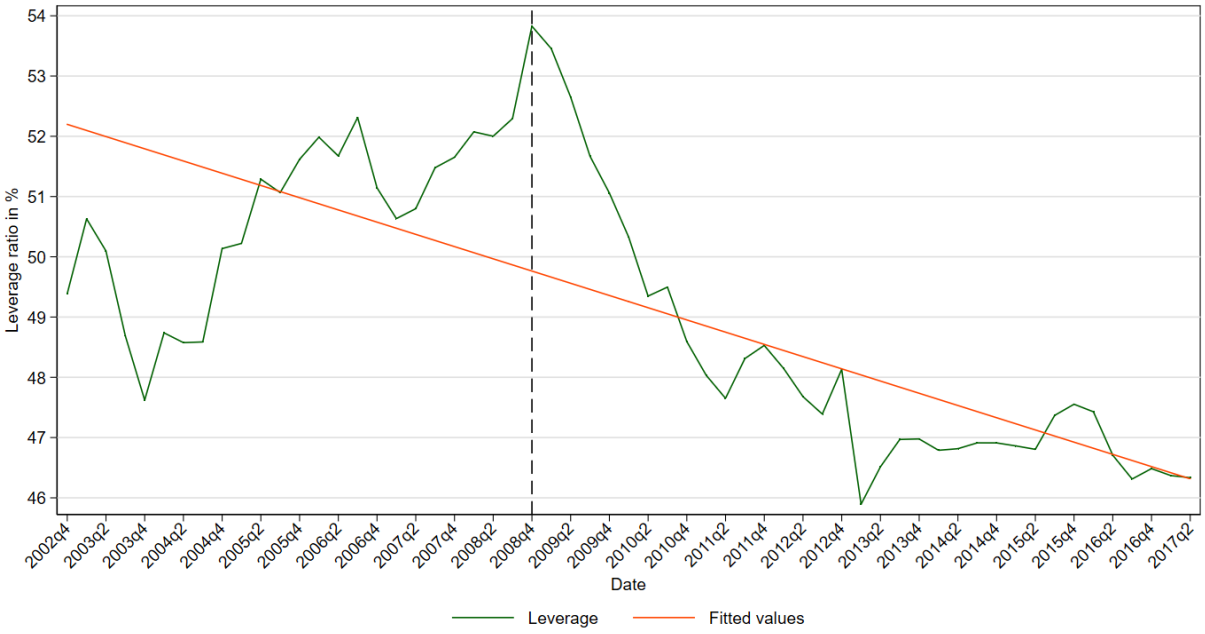
	Assets	Debt	Equity	MarketCap	Leverage	Return
mean	3,334,546	1,691,965	1,391,047	2,534,809	0.4872	3.31
min	8,142	0	-1,787,348	1,910	0.0000	-8.31
max	25,324,830	17,978,696	9,999,590	32,474,382	1.1650	31.46
sd	4,118,998	2,418,408	1,594,892	4,120,914	0.1612	2.38

With an average leverage ratio of 48.72% REITs generate an average return of 3.31% on a quarterly basis. As can be seen in table 1 the minimum and maximum returns vary largely from the mean, although the standard deviation of the return is 2.31. This can be clarified by the fact that one REIT had an extremely high return surrounding it's IPO date (611%) and a relatively short life span, and since the REIT exists as of Q2 2013 this has a large weight on the total return for that REIT. The negative return is less extreme and can be clarified by a high volatility.

As can be seen from figure 1, the leverage ratio decreases over the examined period. To be precise; at the start of the period the average leverage ratio equals 49.39% and decreases to 46.49% over time, with a maximum of 53.83% at Q4 2008. A more detailed analysis of figure 1 shows an upward sloping leverage ratio prior to the financial crisis of 2008 due to over optimism (low perceived risk) and cheap credit (Aiginger, 2011; Caprio, D'Apice, Ferri, and Puopolo, 2010). Schularick and Taylor (2012) suggest that if REITs are considered too big to fail, the prospect of a bailout by the government could have contributed to the high leverage, and that REITs thus willingly overlevered their assets prior to the crisis. Additionally, figure 1 shows a steeper and deeper decline of the leverage ratio after the crisis, which might be attributed to the need for delevering. Since leverage decreased to a lower level than prior to 2008, one could argue that the pre-crisis leverage ratio was perceived as too high to be sustainable in the long-run.

Fig. 1. Leverage development

Leverage shows the average quarterly leverage ratio in percentages of the book values of equity and debt over the analyzed period.

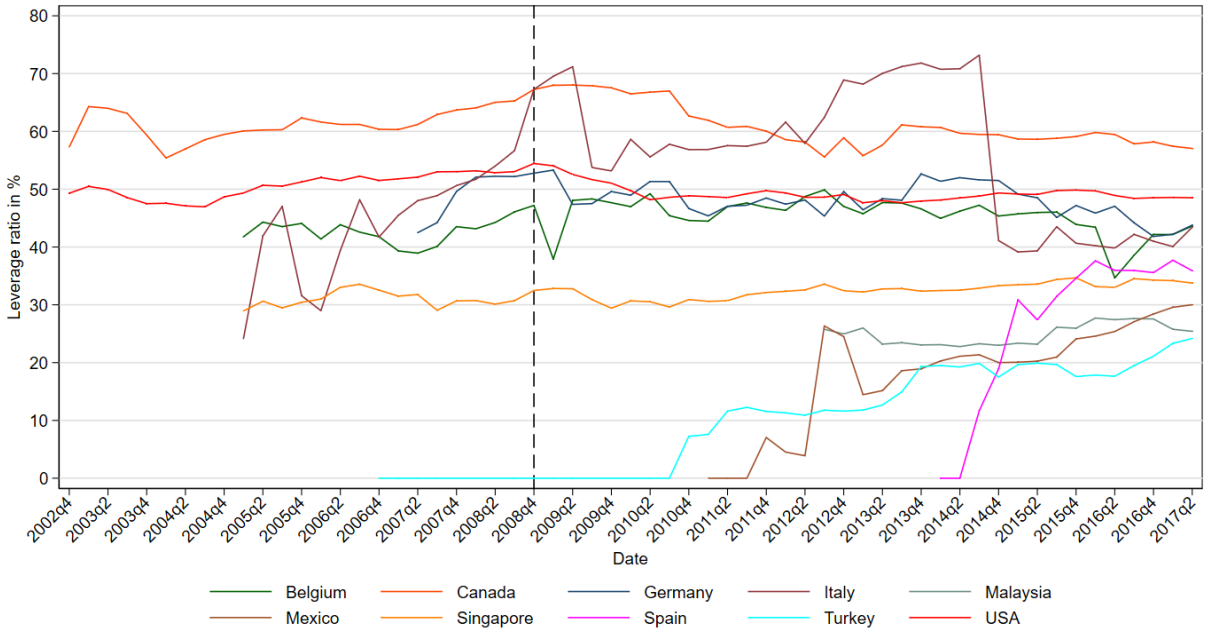


However, the leverage ratios for the individual countries over time, depicted in figure 2, show a different picture; countries where REITs were a legal entity prior to the crisis show increasing leverage ratios prior to the crisis, as is in accordance with figure 1. However, the leverage ratios do not necessarily decrease afterwards. The leverage ratios in Canada, the USA, and in Singapore do decrease shortly after the crisis period, but not as sharply as would be expected based on figure 1. In addition, the Singaporean leverage ratio gradually increases after 2010. So while the average leverage ratio of REITs in countries which experienced the crisis decrease marginally, or even increase after the crisis, the decrease in the leverage ratio from figure 1 is due to the fact that the leverage ratio for countries after the crisis period are lower. Therefore, the notion of high perceived leverage does not necessarily hold for the countries which are included in the sample prior to the crisis. However, it could be argued that countries that are included after the crisis did learn from the high leverage ratio prior to the crisis. However, regulation in those countries does not show a different pattern as was outlined in section 2.

Figure 3 plots the book values of assets, debt, equity, and the market value of equity. From this one can see that increase of the leverage ratio is mainly due to the depreciation of the equity value prior to Q4 2008, which eventually causes firms to liquidate the debt and thus lowering their leverage during and after the crisis. Furthermore, figure 3 shows that

Fig. 2. Country leverage development

Figure 2 shows the average quarterly leverage ratio in percentages of the book values of equity and debt per country over the analyzed period.



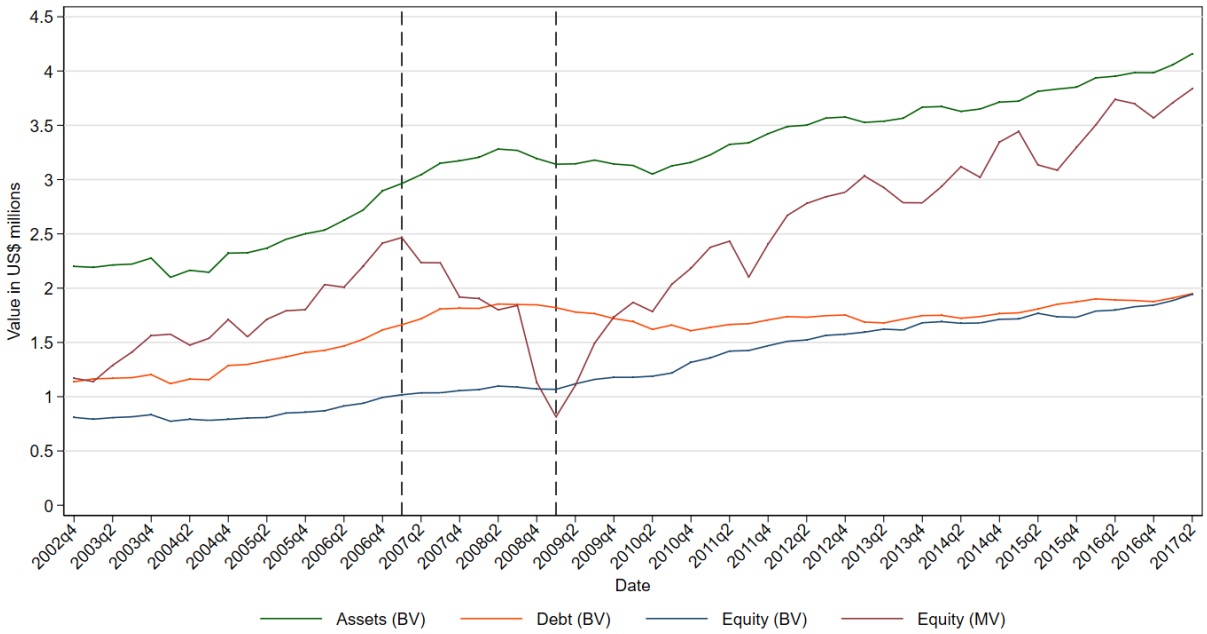
total equity decreases, on average, 1.6 billion US$ from Q1 2007 till Q1 2009, while book values for assets and debt decrease marginally. This causes the market value of the equity to drop below the book value of the equity in Q4 2008. Implying a lack in confidence in the company to generate future cash flows and profits.

Table 2 gives a more in depth analysis of table 1, it states the average assets, market capitalization, leverage and return per country, based on the averages of those values per REIT, as well as the averages over all countries. In addition, it shows the number of REITs and number of sectors in which the REITs operate in per country. The majority, 305, of the 341 REITs is concentrated in the USA, Canada, and Singapore. The fact that most REITs are based in the USA might be explained by the fact that the USA were the first to implement real estate investment trusts as legal entities in 1960. This could also clarify why the USA REITs are also the largest REITs in terms of asset value and market capitalization. The large amount of REITs listed in Singapore, or S-REITs, might be due to the favorable regulation on REITs. The amount of REITs in Canada might be explained by the country size and the developed Canadian economy.

Furthermore, table 2 shows that leverage ratios in Canada, Germany, Italy, and the USA, are above average. For Canadian REITs this might be due to the fact that there is no regulatory leverage maximum in Canada. The high leverage ratio and negative quarterly

Fig. 3. Time-series

Figure 3 shows quarterly average assets, debt and equity in book values. In addition it shows the equity value in market values, denoted by *Equity* (*MV*).



return in Italy might be explained by a 2008-09 crisis effect which lingers on. Other countries have a leverage ratio which is about 15% lower in absolute terms. Leverage seems to be positively related to returns, as the Canadian REITs generate the highest return (apart from Spain) in the sample, while they also have the highest leverage ratio. Note that Spanish REITs generate a higher return, however, Spanish REITs are included as of Q3 2014 and are therefore unaffected by the crisis, while Canadian REITs were affected.

Fama and French (1993) state that small firms with a high book to market ratio tend to outperform large firms with a low book to market ratio. However, a first glance at the market capitalization and returns in table 2 does not show a clear relationship. Neither does it show for the relationship between the book to market ratio and return. However, both aspects will analyzed in full in the second part of the analysis. A similar analysis as table 2 can be made for the different sectors in the sample. The largest REITs have an asset base of nearly 7.4 billion US$ and are operating in the regional mall sector as can be seen in table 3, which reports, apart from the number of REITs, the average REIT values for assets, market capitalization, leverage and return. The market capitalization does not seem to correlate with return, as would be expected based on Fama and French (1993). Neither does a clear relationship arise between leverage and return from table 3.

The average leverage ratio over all sectors equals 48.72%, which is equal to the leverage

Table 2: Country descriptives

Start date states the date as of which the country is included in the analysis. $REITs$ and $Sectors$, respectively, denote the total number of REITs and sectors per country. Values for assets ($Assets$) and market capitalization ($MarketCap$) are reported in thousand US$. Assets are reported in book values, whereas market capitalization is the market value of the equity. Leverage ($Leverage$) is reported on a scale from 0 to 1, whereas the return ($Return$) is reported in percentages. Values for assets, market capitalization, leverage and return depict the averages per REIT per country over the analyzed period.

	Start date	REITs	Sectors	Assets	MarketCap	Leverage	Return
Belgium	1	5	2	1,592,311	815,199	0.4482	2.61
Canada	7	59	9	2,265,076	1,028,886	0.6075	3.23
Germany	6	3	2	1,283,896	547,541	0.4819	2.83
Italy	4	3	2	1,617,210	449,143	0.5232	-0.55
Malaysia	2	7	4	1,555,323	1,291,143	0.2504	2.38
Mexico	5	8	4	2,452,696	1,779,062	0.2184	2.16
Singapore	1	37	8	2,164,918	1,296,691	0.3246	2.81
Spain	3	4	2	2,664,469	1,476,605	0.2874	3.68
Turkey	8	6	3	1,337,317	661,346	0.1360	0.56
USA	7	209	12	3,919,208	3,224,763	0.4974	3.55
Total				3,334,546	2,534,809	0.4872	3.31

ratio for countries, since both are based on the same sample. Do note that the amount of REITs differs, see for instance the leverage ratio of Belgium of 44.82% which is based on five REITs, whereas the leverage ratio of the diversified sector of 47.43% is based on 67 REITs. Note that this holds for all sectors. The reason that manufactured homes, multifamily, regional mall, other retail, and shopping center have above average leverage ratios might stem from the fact that those sectors provide a relatively certain income stream compared to the other sectors. For instance, if a tenant leaves a property from one of the previously mentioned sectors, the REIT can more easily find a new tenant than in the case of a highly specialized property type. Therefore, banks might be less willing to finance the more specialized sectors resulting in a lower leverage ratio. Overall, the highest returns are realized in the specialty sector which also has the highest Sharpe ratio, which measures the return per unit of risk, due to the above average return and below average standard deviation.

In the previous tables the focus was on describing and analyzing the relationship between market capitalization, leverage, and return, whereas we now focus on the riskiness and corresponding return. Therefore, tables 4 and 5 provide the return and the corresponding

Table 3: Sector descriptives

REITs denotes the total number of REITs per sector. Values for assets (*Assets*) and market capitalization (*MarketCap*) are reported in thousand US$. Assets are reported in book values, whereas market capitalization is the market value of the equity. Leverage (*Leverage*) is reported in percentages where 1 implies 100%, whereas the return (*Return*) and standard deviation (*SD*) are reported in percentages where 1 means 1%. The Sharpe ratio (*Sharpe*) is calculated using formula 1. Values for assets, market capitalization and leverage depict the averages per REIT per sector over the analyzed period. Return, standard deviation and the Sharpe ratio are equally-weighted.

	REITs	Assets	MarketCap	Leverage	Return	SD	Sharpe
Diversified	67	2,385,771	1,168,217	0.4743	2.60	10.17	0.27
Health Care	26	3,734,752	3,231,101	0.4584	4.04	10.52	0.38
Hotel	35	2,105,466	1,353,631	0.5105	2.51	14.41	0.17
Industrial	34	3,122,016	2,185,763	0.4557	3.83	9.18	0.42
Manufactured Home	4	1,459,353	1,238,359	0.6701	3.77	8.99	0.42
Multifamily	31	3,469,277	2,739,396	0.5652	3.44	10.48	0.33
Office	40	4,344,629	2,546,147	0.4498	3.08	12.20	0.25
Other Retail	18	2,435,290	1,705,919	0.4958	3.03	9.15	0.34
Regional Mall	16	7,367,686	6,138,954	0.5448	4.32	18.36	0.24
Self-Storage	7	3,571,144	6,262,140	0.3839	4.90	15.49	0.32
Shopping Center	29	3,085,951	2,289,068	0.5010	3.26	12.19	0.27
Specialty	34	4,075,518	4,871,698	0.4248	4.13	8.74	0.47
Total		3,334,546	2,534,809	0.4872	3.31	11.39	0.31

volatility measured by the standard deviation, including the sharpe ratio. Table 4 states these values over the whole analyzed period, whereas table 5 differentiates for the pre-crisis period ranging from Q4 2002 till the second quarter of 2008, since the bankruptcy filing of Lehman Brothers took place in Q3 2008. The prost-crisis period ranges from Q1 2010 till Q2 2017. Because not all REITs are included in the sample at the same time, a cross country analysis over time is impossible.

In order to calculate the return and standard deviation, the country and sector average return and standard deviation are used instead of the return and standard deviation per REIT, as to calculate a more accurate standard deviation. The country and sector return are calculated as the equally-weighted average return from the average REIT return. The country and sector standard deviation are calculated as the standard deviation of the average REIT returns. From table 4 it follows that returns range from -0.55% for Italy, to 3.68% for Spain on a quarterly basis. Important to note is that the Italian REITs are included as of Q2 2005 and Spanish REITs are included as of Q1 2014. Therefore, the crisis effect is present in the Italian returns whereas Spanish REITs are not affected. Thus, one must be careful

with comparing REIT returns and volatility. The time span does not completely clarify the negative return for Italy, since Italy and Singapore have been included in the sample for roughly the same time, and the return pattern for Singaporean REITs is less volatile. Which is graphically represented in appendix C figure 6, or quantitatively in table 4 from which it can be observed that Singaporean REITs have a return of 2.81% with a standard deviation of 1.11% while Italian REITs have a return and standard deviation of, respectively, -0.55% and 2.90%. German REITs generate the highest return per unit of risk, with a sharpe ratio of nearly 5.05.

Table 4: Country return and standard deviation

Start date states the date as of which the country is included in the analysis. *REITs* denotes the total number of REITs per country. Return (*Return*) and standard deviation (*SD*) are reported in percentages where 1 means 1%. The Sharpe ratio (*Sharpe*) is calculated using formula 1. Values for return, standard deviation and the Sharpe ratio depict the averages per REIT per country over the analyzed period.

	Start date	REITs	Return	SD	Sharpe
Belgium	1	5	2.61	0.8182	3.1846
Canada	7	59	3.23	3.2945	0.9805
Germany	6	3	2.83	0.5594	5.0508
Italy	4	3	-0.55	2.8980	-0.1904
Malaysia	2	7	2.38	1.1783	2.0191
Mexico	5	8	2.16	2.1840	0.9887
Singapore	1	37	2.81	1.1122	2.5273
Spain	3	4	3.68	1.3457	2.7325
Turkey	8	6	0.56	3.1567	0.1782
USA	7	209	3.55	2.1633	1.6420
Total			3.31	2.2203	1.6375

Table 5 shows that equally-weighted returns vary across sectors, and range from 1.35% for pre-crisis manufactured home REITs to 11.54% for self-storage REITs. On average the pre-crisis return is 2.72% with a standard deviation of 7.67%, whereas REITs post-crisis generate a higher quarterly return on average of 3.42% with a standard deviation of 8.07%. In the pre-crisis period the specialty REITs have the highest Sharpe ratio, which is predominantly due to the high return compared to the other sectors, while the specialty REITs have an below average standard deviation. In the post-crisis period manufactured home has the highest Sharpe ratio. Compared to self-storage REITs which have a slightly higher quarterly return, the higher Sharpe ratio is caused by the lower standard deviation. The reason for this might be the same as posited previously on the difference between manufactured homes and

specialty REITs. Note that the amount of REITs in the sample increases in time, thus the post-crisis period contains more REITs than the pre-crisis period. Related to the leverage plot in figure 1, one could argue that younger REITs have less debt, since firms are mostly equity financed upon start-up, and therefore reduce the average leverage level. However, since the leverage level in the dataset does not show a noteworthy increase per REIT after the first year (See figure 2), this effect seems limited, and the decreasing leverage ratio seems to be more likely caused by lower leverage ratios in countries that imposed the REIT status after the crisis.

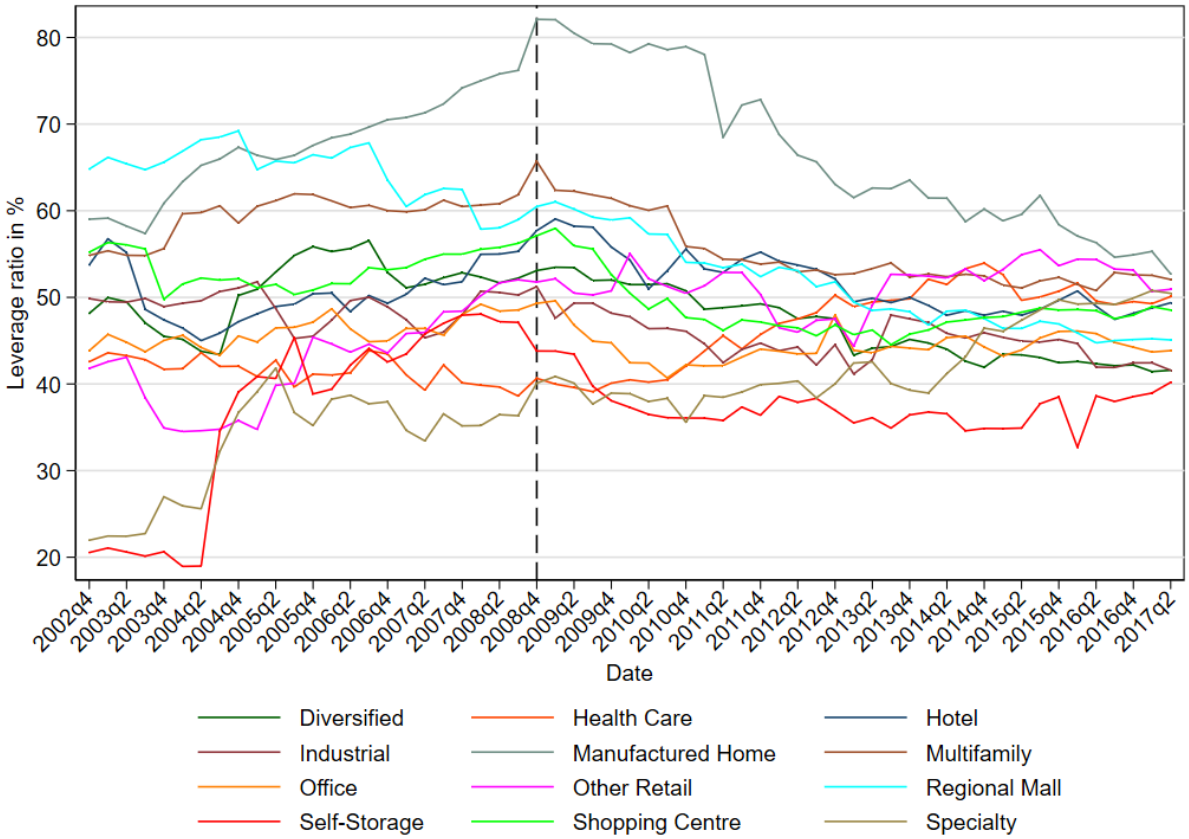
Table 5: Pre- and post-crisis: return, standard deviation, and sharpe ratio

REITs denotes the total number of REITs per sector during the pre-crisis- and post-crisis period. Return (*Return*) and standard deviation (*SD*) are reported in percentages where 1 means 1%. The Sharpe ratio (*Sharpe*) is calculated using formula 1. Values for return, standard deviation and the Sharpe ratio depict the averages per REIT per sector in the pre-crisis- and the post-crisis period. The pre-crisis period ranges from Q4 2002 up to and including Q2 2008. The post-crisis period ranges from Q2 2010 till the end of the sample period, Q2 2017.

Sector	Pre-crisis period				Post-crisis period			
	REITs	Return	SD	Sharpe	REITs	Return	SD	Sharpe
Diversified	37	2.30	6.96	0.3301	66	2.93	8.54	0.3430
Health Care	14	4.07	8.70	0.4674	26	3.60	6.71	0.5365
Hotel	19	1.60	8.55	0.1877	35	2.81	10.45	0.2687
Industrial	13	2.25	6.63	0.3388	34	4.26	6.81	0.6253
Manufactured Home	4	1.35	6.43	0.2104	3	5.77	7.11	0.8108
Multifamily	23	2.71	7.81	0.3465	31	4.06	6.49	0.6256
Office	24	3.06	8.53	0.3584	40	2.89	7.96	0.3631
Other Retail	8	1.23	7.28	0.1695	18	3.15	6.71	0.4696
Regional Mall	10	3.07	10.60	0.2894	16	3.53	8.90	0.3959
Self-Storage	5	2.80	8.08	0.3461	6	6.05	11.54	0.5238
Shopping Center	19	3.55	8.00	0.4435	28	2.95	8.66	0.3405
Specialty	11	3.40	4.86	0.7005	34	3.96	7.65	0.5178
Total		2.72	7.67	0.3522		3.42	8.07	0.4397

Sector returns all follow the same pattern, as can be seen from figure 7 in appendix D, from this we can see that over the whole sample, excluding the crisis period, returns do not diverge much from the mean as concluded from table 5. On a related note, a wide dispersion in leverage ratios can be observed, either between sectors and over time, from figure 4. In general, leverage tends to decrease over time as shown in figure 4. Furthermore, whereas leverage varied widely in the pre-crisis period amongst sectors, after the crisis leverage ratios are more clustered.

Fig. 4. Sector leverage



From the first part of the analysis it followed that the REITs with the highest leverage do not necessarily generate the highest returns, although higher leverage seems positively correlated with returns looking at the discussed tables. This is in line with the leverage graph of figure 1 and 7, and table 5 from which it followed that leverage decreases and returns slightly decreased over time. Thus, one could say that higher leverage might correlate positively with return.

In order to examine this claim in detail, a regression analysis is performed using formula 2. The portfolios on which the regression is based are shown in table 6 and 7. From these tables it can be observed that big REITs with a low book to market ratio tend to outperform other REITs on a quarterly basis, while the big REITs outperform small REITs irregardless of the book to market ratio. This differs from the results that Fama and French (1996) find who state that small firms with a high book to market ratio outperform big firms with a low book to market ratio. The reason for this might be explained by the different assets classes. In addition, REITs with a low book to market ratio outperform REITs with a high book to market ratio, 4.28% versus 3.45%.

Furthermore, table 7 shows the quarterly outperformance of REITs whose performance belonged to the upper 30% over the average group and low group. Small REITs whose performance belonged to the upper 30% in the past year, show the highest quarterly return of 8.64%. REITs whose performance, in terms of returns, belonged to the bottom 30% in the past three quarters continue to underperform other REITs in the next quarter. The significance of the past performance is examined in table 8.

Table 6: Average quarterly portfolio return

Reported values depict the average quarterly return depending on the size and book to market ratio of a REIT relative to the other REITs' size and book to market ratio. The size groups are based on the median, the book to market groups are separated in the lowest 30%, middle 40%, and highest 30%.

	Low	Medium	High
Small	4.2051	4.0073	3.4604
Big	4.3627	3.5525	3.449

Table 7: Average quarterly portfolio return

Reported values depict the average quarterly return depending on the previous year's return relative to the other REITs' size and annual return. The size groups are based on the median, the cumulative return groups are separated in the lowest 30%, middle 40%, and highest 30%.

	Loser	Medium	Winner
Small	-.2989	3.5235	8.6338
Big	.4523	3.5326	7.1192

Using the terminology of Fama and French (1996) the average value weighted SMB effect is -0.1139, implying that big REITs outperform small REITs with an additional 0.1139 return just by being big. For HML this effect is -0.8616, implying that REITs with a high book to market ratio underperfom REITs with a lower book to market ratio. The MOM effect is highly positive, 7.743, which implies that REITs who performed better than the bottom 70% in the past year outperform those REITs with an additional return of 7.743%.

Since the Wald-test for heteroskedasticity rejects the null hypothesis of homoskedasticity (p=0.0000), a first order regression of formula 2 with adjusted Huber/White standard errors is ran. As previously stated, the leverage effect might be non-linear since a REIT can profit

from the tax shield that arises from debt up to a certain point where the bankruptcy risk becomes greater than the profit from the tax shield, and thus reduces returns. The sample is divided into ten groups based on quarterly leverage for which the regression output is shown in table 8. This way the outperformance of a leverage group can be observed. Ten groups are chosen to minimize the differences in leverage within a group, and as to maintain sufficient observations per group. The quarterly leverage ratio is preferred over the average leverage ratio per REIT or other measures, since using the quarterly leverage ratio allows the investor to rebalance the portfolio quarterly and thus profit optimally from his/her portfolio allocation.

Table 8 shows that the market beta is highly significant over all leverage groups. The market beta of 0.937 for the low leverage group, with leverage up to and including 27.1%, is highly significant at the 1%-level. From an economic point of view it makes sense that the market beta for the low leverage group is less than one, since firms (in general) tend to be less volatile with less leverage. Furthermore, table 8 shows an increasing market beta as leverage increases. The SMB factor is insignificant, implying that there is no evidence that small REITs in the low leverage group outperform big REITs in that group. Neither HML is statistically significant for the low leverage group. MOM is significant at hte 10%-level implying that REITs who performed well in the past continue to do so in the future. The constant is significantly negative with a value of -2.197 at the 5%-level, which means that REITs with a low leverage ratio underperform other REITs with an excess return which is 2.197% lower on a quarterly basis, controlling for the market beta, SMB, HML, and momentum factor. Based on 1.124 observations the model is able to explain 23.1% of the variance in the excess return of a REIT with a low leverage ratio. For the second leverage group with leverage up to 35.26%, the size effect is significantly positive at the 5%-level with a coefficient of 0.340. This implies that big REITs outperform small REITs in this leverage group (See table 6) with a factor of 0.340. However, in leverage group six and eight the SMB factor is significantly negative at the 1%-level, indicating that small REITs outperform big REITs. In leverage group 4, with leverage ratios from 41.02% until 45.75%, no evidence of a size effect can be found. However, the book to market ratio effect is statistically significant and contributes negatively to the excess return with a coefficient of -0.247 (5%-level). Implying that a high book to market ratio leads to higher excess returns. Of the examined leverage groups, the constant is significant in only two groups. In those leverage groups the constant is negative which implies that, controlling for the Fama and French (1996); Carhart (1997) factors, leverage contributes negatively to excess returns.

The bottom part of table 8 shows that the excess return of leverage group 3 is the highest, while leverage group 4 yields the highest Sharpe ratio, giving the highest return per unit

of risk. From this it follows that a rational investor should invest in leverage group 4 to yield an optimal excess return. Leverage group 4 consists of a diversified portfolio of nine countries and all twelve sectors, as can be seen in table 15 in appendix E. This thus provides diversification possibilities as well as the highest excess return.

Table 8: First order regression of excess return with constrained leverage

The regression is performed over ten leverage groups. The market beta (*Market beta*) gives the effect of the market return on the excess return for that particular leverage group. The excess market return is given by the average market return at date t over the risk-free rate. SMB, HML, and MOM respectively denote the small minus big, high minus low, and momentum factors outlined in section 3. The amount of observations differs per group despite the idea to create equally sized groups due to the fact that multiple leverage ratios are the same. The separation point for leverage groups is given by *Maximum leverage*, which gives the maximum leverage ratio for the leverage group. Excess return (*Excess return*) and standard deviation (SD) are reported in percentages. The Sharpe ratio (*Sharpe*) is calculated using formula 1. Values for return, standard deviation and the Sharpe ratio depict the quarterly equally-weighted averages per leverage group.

	Low	2	3	4	5	6	7	8	9	High
Market beta	0.937***	0.921***	1.020***	1.071***	0.989***	1.074***	1.122***	1.012***	1.057***	1.057***
	(6.28)	(14.57)	(11.74)	(12.95)	(14.42)	(18.59)	(11.70)	(14.39)	(11.44)	(8.21)
SMB	0.390	0.340**	0.404	-0.129	-0.220	-0.499***	0.036	-0.534***	0.001	-0.007
	(1.34)	(2.27)	(1.10)	(-0.69)	(-1.15)	(-3.29)	(0.07)	(-2.64)	(0.01)	(-0.02)
HML	0.027	0.134	0.109	-0.247**	-0.001	-0.166	-0.212*	-0.162*	-0.003	0.159
	(0.17)	(1.19)	(0.83)	(-2.52)	(-0.01)	(-1.08)	(-1.93)	(-1.93)	(-0.03)	(1.06)
MOM	0.192*	0.001	-0.021	-0.105	0.147*	0.137	-0.096	-0.098	0.113	-0.023
	(1.82)	(0.01)	(-0.18)	(-1.10)	(1.82)	(0.87)	(-1.07)	(-0.90)	(1.14)	(-0.14)
Constant	-2.197**	-0.178	0.362	0.146	-1.480**	-0.794	-0.029	0.515	-1.015	0.456
	(-2.10)	(-0.24)	(0.40)	(0.20)	(-2.34)	(-0.78)	(-0.04)	(0.54)	(-1.25)	(0.32)
Observations	1124	1198	1185	1165	1189	1188	1175	1167	1165	1155
Adjusted R^2	0.231	0.334	0.325	0.417	0.490	0.469	0.350	0.461	0.399	0.190
Maximum leverage	.271	.3526	.4102	.4575	.4946	.5339	.5735	.627	.7075	1.9318
Excess return	1.79	2.29	3.18	2.9	2.49	2.95	2.24	1.86	2.12	2.94
SD	18.57	14.58	16.2	14.66	15.81	15.93	17.18	20.13	20.74	31.61
Sharpe ratio	.0965	.1571	.1964	.1976	.1572	.1853	.1303	.0922	.1021	.0929

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Due to the use of book values leverage shows low correlation with the SMB, HML, and MOM factors, as well as with the market beta as can be observed from table 9, which gives the correlation for the whole portfolio. The correlation with the market beta of -0.016 is significant at the low 10%-level, implying that leverage decreases slightly as the market beta increases. Furthermore, leverage shows a significantly positive relationship with the momentum factor of 0.046 (1%-level). However, momentum itself is significant in only one of the examined leverage groups. The low correlation between leverage and the Fama and French (1996); Carhart (1997) factors implies that the influence of the other factors can vary across leverage groups. SMB, HML, and MOM, however, correlate significantly with the market beta for, respectively, -65.2%, 54.1%, and 28.4%. The SMB, HML, and MOM factor show significant correlations as well.

Table 9: Correlation matrix

Correlation table of the factors used in regression formula 2. Supplemented by *Leverage* which gives the ratio of debt over equity in book values.

	Market beta	SMB	HML	MOM	Leverage
Market beta	1.000				
SMB	-0.652***	1.000			
HML	0.541***	-0.438***	1.000		
MOM	0.284***	-0.206***	0.112***	1.000	
Leverage	-0.016*	-0.006	0.014	0.046***	1.000

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Since excess returns do not increase significantly with the leverage ratio, no linear relationship between leverage and excess return can be derived from table 8. However, certain sectors or countries might significantly influence the excess returns based on the prior discussed literature and the data analysis. Since table 8 concluded that leverage group 4 yields the highest Sharpe ratio, the regression of formula 2 is performed a second and third time including respectively sector and country dummies for leverage group 4 by using formula 4 and 5.

Both regression are performed using random effects since the sector and country effect do not vary over time and the Hausman test cannot reject the null-hypothesis of random effects (p-value = 0.1781 and 0.2670, respectively). Results from formula 4 and 5 are stated, respectively, in table 12 and 10, and show that the market beta remains highly significant with a coefficient close to one, and HML becomes less negative but remains significant. Other factors from the first regression remain insignificant. However, operating in the manufactured home sector decreases excess return by -3.545 at the 1%-level. This might also be explained

by the fact that leverage group 4 has only one observation for the manufactured home sector. The country effect for Canada is significant at the 5%-level with a coefficient of 3.324. Furthermore, REITs in Mexico and USA show significant positive effects as well, while the country effect is negative for Italy and Turkey. From this analysis it follows that there are indeed some significant differences between sectors and countries.

Table 10: Leverage group 4 regression

Random effects regression of regression 2 to examine the sector effect in leverage group 4. Coefficients on sectors show the difference to the diversified sector. Dependent variable is the quarterly excess return.

	Model 1	
Market beta	1.039***	(13.88)
SMB	-0.138	(-0.81)
HML	-0.201*	(-2.32)
MOM	-0.055	(-0.69)
Diversified	0.000	(.)
Health Care	-0.798	(-0.74)
Hotel	-1.392	(-1.15)
Industrial	-0.222	(-0.19)
Manufactured Home	-3.545***	(-3.71)
Multifamily	1.315	(1.11)
Office	-1.325	(-1.27)
Other Retail	0.534	(0.45)
Regional Mall	-0.792	(-0.43)
Self-Storage	0.348	(0.39)
Shopping Center	-0.583	(-0.55)
Specialty	-0.471	(-0.26)
Constant	0.397	(0.36)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

From both table 10 and 12 it can be observed that there are differences between sectors and countries. This allows for portfolio optimization by shorting or going long specific REITs. In addition, by doing so the portfolio becomes more diversified than by investing in one REIT based on tables discussed earlier. Following classical portfolio theory the optimum portfolio is derived by calculating the tangency portfolio using all quarterly returns. The weights on every sector in the tangency portfolio are calculated as follows:

$$\omega = \frac{\Omega^{-1}(r - r_f)}{1'\Omega^{-1}(r_f)} \tag{7}$$

where Ω^{-1} the inverse variance-covariance matrix, r the quarterly return, r_f the risk-free rate, and $1'$ denotes a transpose vector of ones. The weights, ω, can then be used

to calculate the portfolio expected return, standard deviation and Sharpe ratio, which are stated in table 11 for leverage group low, 4 and for the whole sample. This allows examination and comparison of the values across groups and thus whether the optimal leverage group to invest in, if one wants to have limited exposure to leverage, is the low leverage group. For the whole sample the data is winsorized at the 97.5^{th} percentile, based on leverage, to limit the effect of outliers.

Table 11: Leverage group portfolio's

Portfolio return, *Portfolio SD*, and *Sharpe* respectively denote the average quarterly return of the specific country/sector portfolio, the country's/sector's standard deviation of the average quarterly return, and the Sharpe ratio of the country's/sector's return for the low and fourth portfolio, as well as for the whole sample.

	Low		4		Total
	Country	Sector	Country	Sector	
Portfolio return	2.6384	5.0676	3.1244	6.6902	0
Portfolio variance	0.8415	74.5599	85.9986	167.7848	0
Portfolio SD	0.9173	8.6348	9.2735	12.9532	0
Sharpe	2.8762	0.5869	0.3369	0.5165	0
Risk-free rate	0	0	0	0	0

From table 11 it follows that the low leverage group has the highest Sharpe ratio if the portfolio is constructed over the sectors in the low leverage group. This leads to a return of 2.6384% with a Sharpe ratio of 2.8762. Note that not all countries/sectors are included in every leverage group as can be seen in table 15 in appendix E, which limits the diversification possibilities. Although adding additional REIT returns improves the diversification possibilities, it reduces the Sharpe ratio, since returns increase less than the standard deviation. Since certain dates are more represented in one group than they are in other groups, the risk-free rate differs between groups.

From table 8 it followed that, after controlling for the familiar factors, different leverage ratios have different effects on excess return. The difference in excess returns depending on leverage can be graphically represented in figure 5 which plots the excess returns versus the leverage ratio per REIT. In addition, a lowess regression is plotted, which is generated by a locally weighted regression of average REIT excess return on average REIT leverage. It follows that, in line with table 8, REITs with a leverage ratio between 40% and 45% generate the highest excess returns. Leverage ratios above 45% seem to be correlated slightly lower returns. Related to table 11 it can be seen that although leverage increases, excess returns

do not increase much, thus the Sharpe ratio declines.

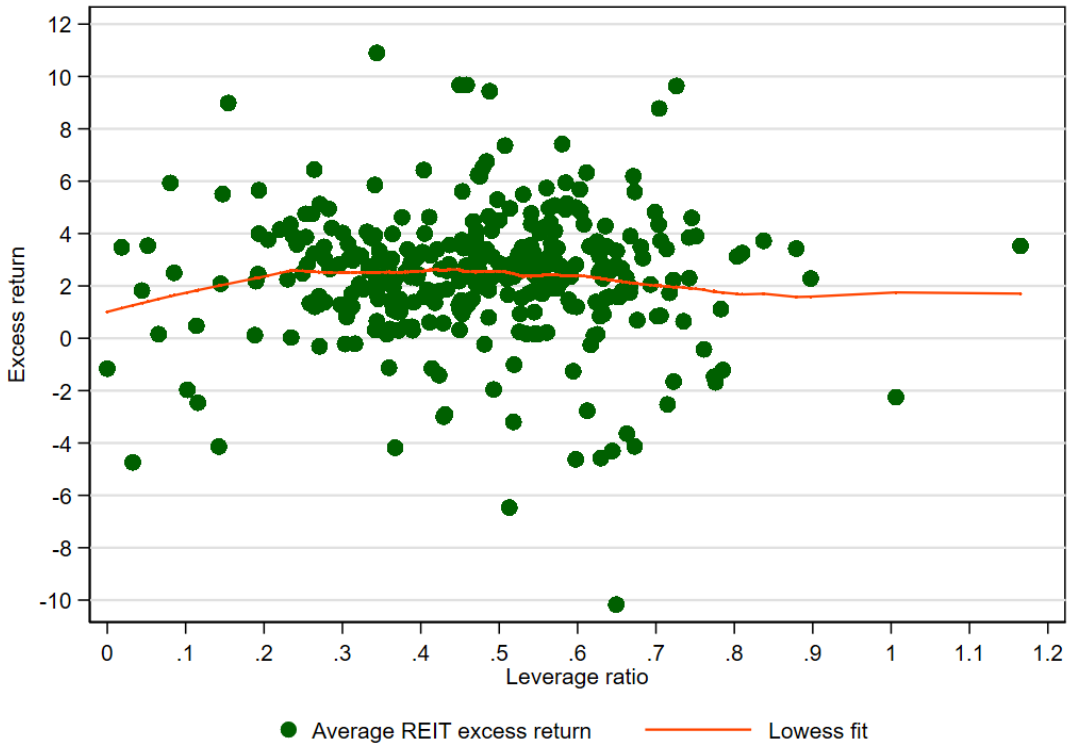
Table 12: Leverage group 4 regression

Random effects regression of regression 2 to examine the country effect in leverage group 4. Coefficients on countries show the difference to Belgium. Dependent variable is the quarterly excess return.

	Model 1	
Market beta	1.030***	(13.71)
SMB	-0.148	(-0.86)
HML	-0.195*	(-2.28)
MOM	-0.054	(-0.66)
Belgium	0.000	(.)
Canada	3.324**	(2.83)
Germany	1.348	(1.17)
Italy	-2.582	(-0.75)
Malaysia	0.000	(.)
Mexico	10.440*	(2.20)
Singapore	2.913**	(2.70)
Spain	5.119	(0.33)
Turkey	-3.398***	(-3.68)
USA	2.204***	(3.98)
Constant	-2.311**	(-2.78)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Fig. 5. Average REIT excess return versus average REIT leverage



5. Results

Based on an international sample of 341 REITs this thesis analyzed the leverage component in the real estate sector. Compared to other asset classes the REIT sector is heavily leveraged with a leverage ratio of 47.53% versus 29% for other industries. The higher leverage ratio might be explained by the tax shield that arises from debt and the relatively certain cash flows. REITs generate an average quarterly return of 3.34% with a leverage ratio of 47.53%, which is close to the optimum leverage ratio that was found by the regression analysis of formula 2.

From the data analysis it followed that on average leverage decreased after the crisis. It could be argued that that leverage prior to the crisis was perceived as to high and unsustainable in the long run. However, a more in-depth analysis shows that the lower leverage ratio arises from different countries that impose REITs as a legal entity which have a lower leverage ratio (See figure 2).

Figure 3 then shows that debt increases, while returns have decreased over the same period (See table 5). Subsequently, one might state that leverage is negatively correlated

with returns in the REIT sector. This statement is formally tested in the latter part of the analysis which concluded that, after controlling for size, book to market, and momentum effects, leverage has a negative effect on the excess return of REITs of -2.257 (at the 10%-level) in the low leverage group, and -1.259 at a significance level of 10% in the leverage group with leverage ratios varying from 45.75% till 49.46%. A rationale might be that having a little leverage imposes more constraints on a REIT than that it contributes to the excess returns via the tax shield so that the overall effect is negative. While this effect might vanish if a REIT has more leverage. Results are robust across sectors and countries. However, being a manufactured home REIT, or a REIT in Canada, Mexico, Singapore, Turkey or the USA significantly influences the excess return by, respectively, -3.535 (1%-level), 3.481 (5%-level), 10.66 (10%-level), 2.988 (5%-level), -3.289 (1%-level) and 2.320 (1%-level). Proposition 1 is thus partly rejected as leverage has negative effects on returns in certain leverage groups. Furthermore, since differences exist in returns for sectors and countries proposition 2 and 3 are both rejected.

Despite the negative relationship between leverage and excess returns for certain leverage groups, the above mentioned REITs, who have a leverage ratio of 41.02% to 45.75% generate the highest excess returns. There might thus be other effects influencing the excess returns offsetting the negative leverage effect.

Since excess returns decreased in the post-crisis period compared to excess returns prior to the crisis, which might be due to the fact that cheap credit drove excess returns prior to the crisis, a similar regression as performed in table 8 is performed over the pre-crisis period and over the post-crisis period.[3] Results indicate that the low and high leverage group significantly underperform other leverage groups in the pre-crisis period, whereas in the post-crisis period only the low leverage group underperforms.

Although leverage contributes negatively to excess returns as was concluded in the low leverage group, it is possible to create a diversified portfolio of REITs in the low leverage group to obtain a higher excess return given the Sharpe ratio of the low leverage group and those of leverage group 4 and the whole sample (See table 11).

6. Conclusion

From table 4 it followed that German REITs have the highest Sharpe ratio, which is due to the low standard deviation of the REIT return. Thus, picking German REITs provide the most certain income stream, leading to the highest return per unit of risk. From table 3 it was concluded that the specialty REIT sector yielded the highest return, with a leverage

[3]Results are reported in respectively appendix A and B.

ratio of 45.57%. Sharpe ratios are less dispersed than Sharpe ratios for countries, which might be due to different underlying risk factors. The highest sector Sharpe ratio is the one for manufactured homes (0.81), for which the same reasoning goes as for the German REITs.

However, solely looking at a specific sector and/or country would surpass the leverage argument. Therefore, based on table 8, the optimum portfolio allocation was calculated for the leverage group with the highest Sharpe ratio, the whole sample, and for the low leverage group. This led to the ability to form a diversified portfolio over eleven sectors with a excess return of 6.69% and a Sharpe ratio of 0.5165 for leverage group 4. Diversifying across countries is less effective as the Sharpe ratio for countries equals 0.3369 in leverage group 4. For the low leverage group however, the Sharpe ratio over countries equals 2.8762 and a return of 2.64%. This implies that when looking at the risk return profile, the low leverage group is more efficient compared to leverage group 4 as can be derived from figure 5. One must note however that diversification possibilities are different for countries/sectors in the leverage groups.

According to portfolio theory, any combination can be made with a risk-free asset and a risky asset to generate a portfolio return. This portfolio can be optimized by investing in a portfolio of risky assets which yield the highest Sharpe ratio, in this case the REITs in the low leverage group. One would thus invest in the risk-free asset with weight x and in low-leverage REITs with weight $(1 - x)$ to obtain the optimum trade-off between risk and return. Based on the desired level of risk one can allocate more weight on the risk-free asset if one is risk averse, or more to the 'risky' REITs with low leverage.

Results show that REITs with the highest excess return do not have the highest leverage. Which is in line with the expected return based on leverage from table 8 since REITs would be better of having 41.02% to 45.75% leverage to maximize their return. It can be concluded that leverage contributes negatively to excess returns for REITs with low leverage ratios and for REITs with leverage ratios between 45.8% and 49.5%. However, the optimal portfolio related to risk/return is formed by REITs in the low leverage group. Which is in line with the examination of Baum, Fear, and Colley (2012). REITs with leverage seem to have specific characteristics that improve excess returns more than leverage decreases excess returns (if leverage has influence), which might be related to the used control variables size, book to market ratio, and momentum. For size a positive effect is found (See table 6, which is in line with Brounen and de Koning (2014).

6.1. Discussion

To my knowledge this is the first paper to examine differences in leverage over sectors using a global dataset. Although it has advantages from a generalization perspective, it is also limited in the amount of observations across countries and sectors based on the sampling criteria. The analyzed sectors in table 5 have different sizes in terms of REITs. It is tricky to compare a sector with three REITs with a sector of 69 REITs. Since the effect of outliers in the former are greater. Thus, if possible, future research might want to incorporate more REITs per sector to enhance the validity of the outcomes in this thesis.

The comment on leverage decreasing to a new, lower, ratio could be formally tested in other papers. However, it is not the objective of this paper to examine this particular point.

From the data section it followed that German REITs, and REITs in the specialty sector yield the highest return per unit of risk. Combining these results would suggest that German REITs in the specialty sector yield the highest return. However, again, due to limited observations and REITs per country, a cross-country and sector analysis is of this statement is impossible. On the other hand, such an analysis neglects the leverage part which is of interest in this thesis.

Appendix A. Pre-crisis analysis

Table 13: First order regression of excess return with constrained leverage in the pre-crisis period

The regression is performed over ten leverage groups for the period ranging from Q4 2002 until Q2 2008. The market beta (*Market beta*) gives the effect of the market return on the excess return. The excess market return is given by the average market return at date t over the risk-free rate. SMB, HML, and MOM respectively denote the small minus big, high minus low, and momentum factors outlined in section 3. The amount of observations differs per group despite the idea to create equally sized groups due to the fact that multiple leverage ratios are the same. The separation point for leverage groups is given by *Maximum leverage*, which gives the maximum leverage ratio for the leverage group. Excess return (*Excess return*) and standard deviation (SD) are reported in percentages. The Sharpe ratio (*Sharpe*) is calculated using formula 1. Values for return, standard deviation and the Sharpe ratio depict the quarterly equally-weighted averages per leverage group.

	Low	2	3	4	5	6	7	8	9	High
Market beta	0.840***	1.241***	1.099***	1.087***	1.006***	1.062***	0.970***	1.070***	1.007***	1.118***
	(6.32)	(8.16)	(6.62)	(10.84)	(12.19)	(12.24)	(15.09)	(7.71)	(10.47)	(11.49)
SMB	-0.198	0.610*	-0.087	-0.039	-0.276	-0.135	-0.561***	0.029	-0.061	0.049
	(-0.83)	(1.92)	(-0.38)	(-0.14)	(-1.33)	(-0.46)	(-3.11)	(0.05)	(-0.29)	(0.21)
HML	-0.043	-0.005	-0.142	0.066	-0.053	0.040	0.175	0.255	-0.162	0.064
	(-0.21)	(-0.02)	(-0.86)	(0.33)	(-0.39)	(0.14)	(1.16)	(1.15)	(-1.05)	(0.37)
MOM	0.179	0.189	0.173	-0.041	-0.125	-0.067	-0.079	0.111	0.036	0.308*
	(1.23)	(0.84)	(0.69)	(-0.16)	(-0.87)	(-0.38)	(-0.57)	(0.38)	(0.24)	(1.75)
Constant	-2.328**	-0.949	-1.680	-0.661	-0.526	0.122	0.081	-0.715	-0.993	-2.893**
	(-2.26)	(-0.62)	(-1.04)	(-0.40)	(-0.50)	(0.11)	(0.08)	(-0.39)	(-0.98)	(-2.37)
Observations	309	205	173	231	310	332	382	400	383	361
Adjusted R^2	0.284	0.357	0.439	0.487	0.442	0.461	0.401	0.319	0.347	0.412
Maximum leverage	.271	.3526	.4102	.4575	.4946	.5339	.5735	.627	.7075	1.9318
Excess return	1.79	2.29	3.18	2.9	2.49	2.95	2.24	1.86	2.12	2.94
SD	18.57	14.58	16.2	14.66	15.81	15.93	17.18	20.13	20.74	31.61
Sharpe ratio	.0965	.1571	.1964	.1976	.1572	.1853	.1303	.0922	.1021	.0929

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix B. Post-crisis analysis

Table 14: First order regression of excess return with constrained leverage in the post-crisis period

The regression is performed over ten leverage groups for the period ranging from Q2 2010 until Q2 2017. The market beta (*Market beta*) gives the effect of the market return on the excess return. The excess market return is given by the average market return at date t over the risk-free rate. SMB, HML, and MOM respectively denote the small minus big, high minus low, and momentum factors outlined in section 3. The amount of observations differs per group despite the idea to create equally sized groups due to the fact that multiple leverage ratios are the same. The separation point for leverage groups is given by *Maximum leverage*, which gives the maximum leverage ratio for the leverage group. Excess return (*Excess return*) and standard deviation (SD) are reported in percentages. The Sharpe ratio (*Sharpe*) is calculated using formula 1. Values for return, standard deviation and the Sharpe ratio depict the quarterly equally-weighted averages per leverage group.

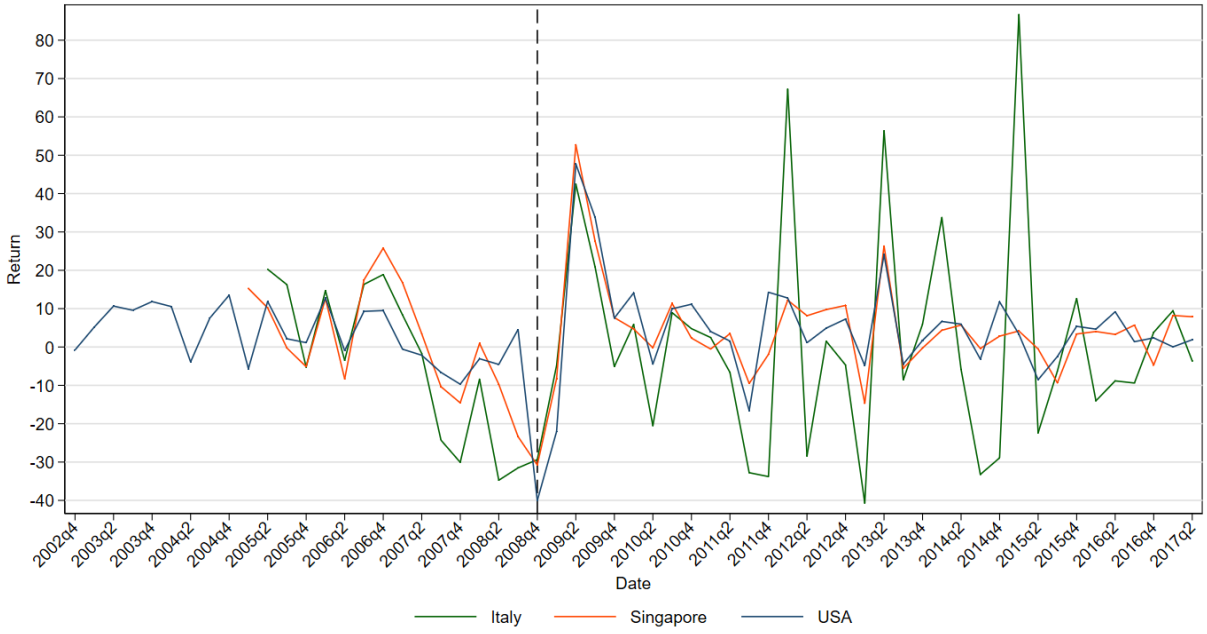
	Low	2	3	4	5	6	7	8	9	High
Market beta	1.053***	0.981***	0.964***	1.074***	0.925***	1.202***	0.915***	0.864***	1.072***	0.969***
	(6.35)	(11.00)	(10.01)	(11.38)	(8.83)	(12.52)	(8.38)	(6.16)	(8.00)	(3.52)
SMB	0.096	0.138	0.085	-0.388***	-0.171	-0.393***	-0.213*	-0.157	0.192	0.779***
	(0.69)	(1.07)	(0.73)	(-2.69)	(-1.28)	(-3.12)	(-1.69)	(-1.00)	(0.91)	(2.68)
HML	0.239*	0.249**	-0.034	-0.327***	-0.195	-0.081	0.057	-0.349**	-0.017	0.245
	(1.70)	(2.05)	(-0.30)	(-2.95)	(-1.15)	(-0.70)	(0.44)	(-2.29)	(-0.09)	(0.60)
MOM	0.383*	-0.175	-0.176	-0.095	0.137	0.141	0.263*	-0.026	-0.185	0.034
	(1.74)	(-1.60)	(-1.53)	(-0.73)	(0.66)	(1.11)	(1.70)	(-0.14)	(-1.13)	(0.09)
Constant	-3.324*	0.692	1.246	0.119	-1.028	-0.783	-1.390	0.306	1.098	0.847
	(-1.82)	(1.00)	(1.55)	(0.13)	(-0.85)	(-0.97)	(-1.20)	(0.24)	(1.05)	(0.40)
Observations	722	920	922	863	783	784	698	597	644	630
Adjusted R^2	0.216	0.260	0.282	0.321	0.282	0.413	0.356	0.184	0.229	0.042
Maximum leverage	.271	.3526	.4102	.4575	.4946	.5339	.5735	.627	.7075	1.9318
Excess return	1.79	2.29	3.18	2.9	2.49	2.95	2.24	1.86	2.12	2.94
SD	18.57	14.58	16.2	14.66	15.81	15.93	17.18	20.13	20.74	31.61
Sharpe ratio	.0965	.1571	.1964	.1976	.1572	.1853	.1303	.0922	.1021	.0929

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix C. Country volatility

Fig. 6. Country return



Appendix D. Sector Return

Fig. 7. Sector return

Appendix E. Portfolio diversification

Table 15: Countries and sectors per leverage group

	Low	1	2	3	4	5	6	7	8	High	Total
Belgium	6	20	39	41	53	24	34	4	0	0	221
Canada	22	4	65	167	150	209	262	302	355	398	1,934
Germany	0	0	7	26	29	38	8	5	0	0	113
Italy	5	13	10	5	13	8	21	10	6	13	104
Malaysia	57	36	8	0	0	0	0	0	0	0	101
Mexico	79	31	21	3	5	4	0	0	0	0	143
Singapore	157	514	336	54	6	1	9	1	0	0	1,078
Spain	22	10	10	2	7	1	0	0	0	0	52
Turkey	142	21	10	5	1	0	1	2	0	0	182
USA	728	570	712	916	955	933	884	894	858	808	8,258
Total	1,218	1,219	1,218	1,219	1,219	1,218	1,219	1,218	1,219	1,219	12,186
Diversified	344	239	200	175	224	186	189	173	276	337	2,343
Health Care	125	71	93	136	104	117	71	67	56	73	913
Hotel	132	136	181	117	89	85	71	97	146	232	1,286
Industrial	58	181	173	112	125	123	142	89	23	35	1,061
Manufactured Home	0	0	1	1	17	29	16	39	33	65	201
Multifamily	32	40	100	85	125	136	195	184	228	204	1,329
Office	119	177	176	220	195	222	178	153	52	6	1,498
Other Retail	38	56	83	73	53	41	35	64	94	38	575
Regional Mall	65	146	15	7	6	19	15	40	119	174	606
Self-Storage	60	6	20	45	31	24	23	27	8	1	245
Shopping Center	108	43	53	157	154	155	207	188	120	42	1,227
Specialty	137	124	123	91	96	81	77	97	64	12	902
Total	1,218	1,219	1,218	1,219	1,219	1,218	1,219	1,218	1,219	1,219	12,186

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