BREEAM CERTIFICATION AND GROSS RENTAL YIELD OF DUTCH RETAIL REAL ESTATE

MASTER THESIS

Peter-Jan Reinders – S2740095

28 October 2020

ABSTRACT. Current literature on the relation between sustainability and financial performance of real estate is primarily focused on the US and UK office sector. Hence, there is relatively limited focus on the Dutch retail real estate sector, specifically. This research is therefore focused on the relation of the sustainability label BREEAM, presented as relative score or number of obtained Stars, and the financial performance of retail real estate in the Netherlands. To that extent, research is conducted on the Gross Rental Yield (GRY) of 89 retail buildings at 40 locations in the Netherlands. Based on retail real estate investor data, a hedonic pricing model is designed and applied to research the GRY as a function of BREEAM, plus additional control variables. Obtaining a BREEAM label or not gives a counterintuitive model outcome. The GRY however decreases by 0.024 base points, with a 1% increase in BREEAM-score. Results on achieving a higher order of BREEAM certification, more Stars, remain however inconclusive for retail buildings in general, except for achieving a 2 Star certification, indicating a 0.833 basepoint decrease in GRY. Regression results on two different types of retail real estate, Comparison and Convenience, show that the expected relations are present, however remain statistically inconclusive. Nevertheless, when 2 Star Convenience buildings are compared to 0 Star buildings GRY lowers with 0.859 base points. Further research, with a broader and more specified dataset, is recommended to deepen insights and provide improved statistical significance.

Keywords: BREEAM, gross rental yield, sustainability label, retail real estate

COLOFON

Title	BREEAM CERTIFICATION AND GROSS RENTAL YIELD OF DUTCH RETAIL REAL ESTATE
Date	28 October 2020
Version	Draft Master Thesis
Author	Peter-Jan Reinders
E-mail	M.P.Reinders@student.rug.nl
Student number	S2740095
Primary Supervisor	Dr. Xiaolong Liu
Secondary Supervisor	Prof. dr. Ed Nozeman,

University of Groningen, Faculty of Spatial Sciences
In association with Colliers International & Altera

Disclaimer: "Master theses are preliminary materials to stimulate discussion and critical comment. The analysis and conclusions set forth are those of the author and do not indicate concurrence by the supervisor or research staff."

PREFACE

With this master thesis, I am completing my Real Estate Studies Master at the University of Groningen. First, I would like to thank dr. Xiaolong Liu for his clear feedback and discussions during the process of this thesis. His directions and comments motivated me to go the extra mile in this research.

In addition, I am very thankful for having met the men and women who created the environment for a superb time during my student career. Special thanks to emeritus prof. dr. E.F. Nozeman, prof. dr. ir. A.J. van der Vlist and dr. M. van Duijn for their contribution and support during my time at the University.

At the start of the third quarter of this academic year, I have been granted an intern position at Colliers International (Colliers) in Amsterdam that set the stage for professional growth. Colliers gave me the chance to write a thesis and participate in the Valuation Department. Even though the Covid-19 situation halted my possibilities to work physically at the office after about six weeks, the support of Colliers International went from the office floor to the living room at home by means of mails, video chats and calls. Thank you Colliers International.

My mentor at Colliers was Paul Nelisse FRICS Ph.D. His guidance, patience and precision have taught me a lot. In times of minor crisis, we evaluated the situation, made a strategy, and often nipped the issue in the bud. Thank you, Paul, you have been a true mentor. Special thanks to the Retail Valuations team and Hill Bos for their advice and providing an informative experience. This research has been made possible by the enthusiastic ir. ing. Ellen Tak-Zwetheul from Altera.

Finally, I thank my family and friends for their support and patience during the past period of focus on this study.

Hopefully, you will enjoy reading this thesis, which I believe could add to the current knowledge regarding sustainability and retail real estate and could support valuators, investors, and owners in their decision making.

Peter-Jan Reinders
Groningen, October 28th , 2020

Table of Contents

1. INTRODUCTION

Real estate, both commercial and residential, faces an ecological sustainability challenge. In recent years, the impact of the real estate sector on climate change is becoming more apparent within society (Younger et al., 2008). The real estate sector is responsible for about 40% of the global energy consumption and contributes up to 30% of the annual global greenhouse emissions (UNEP Finance Initiative, 2015).

To commit to creating a more sustainable world, the United Nations signed the Paris Treaty, known as Paris Proof 2050 (UNEP, 2019), aimed at using only sustainably generated energy in 2050 and lower national emissions by 95% in 2050 compared to 1990. Nations have translated this goal into governmental regulations and policies, such as using more sustainable non-PFAS plastics in construction in the Netherlands (RVO, 2020). To become more sustainable, the energy-consumption and emissions of real estate need to be lowered.

Sustainable real estate ties together both environmental and economic components and can be realized by improving the current stock. Environmentally, sustainable real estate aims to limit the impact on the natural environment and public health in terms of managing its operations, energy consumption, water usage, waste, construction materials and more, during the total lifecycle (Darko et al., 2017; DGBC, 2020). At the same time, sustainable real estate delivers economically stable and long-term financial value (Fuerst & McAllister, 2011; Kok & Jennen, 2012). Literature describes two categories of sustainability labels functioning as normalised performance indicators. One category is focused solely on energy performance such as Energy Performance Coefficient (EPC) and Energy Star, the other category is focused on more aspects of sustainability, such as Leadership in Energy, Environmental Design (LEED) and Building Research Establishment Environmental Assessment Method (BREEAM). Contrary to the first category, the second category provides an overall environmental performance score, after assessment of a building, rather than simply stating its energy efficiency. This overall score reflects aspects such as energy-consumption, waste flows, water usage, public health, environmental impact and more.

Three trends intensify the financial and environmental pressure on investors and retailers to show their sustainability-performance and their social responsibilities. Sustainability labelling could solve the problems associated with the trends. The first trend, the digitalisation of retail (e-commerce) causes a decrease in stock of physical stores causing a widespread decline in both peripheral and centre locations (Syntrus, 2019; KPMG, 2020). By operating sustainably, hybrid (digital and physical) retailers could adapt to this trend, making them more resilient. The second trend shows that, customers such as millennials, have become more focused on the ideals and core sustainable values of a business, rather than just on the actual products and services they sell. There are increasing premiums in sales and revenues in more experience-focused practices (KMPG, 2020). The last trend states that retailers are increasingly expected to own up to their core values and be socially responsible (Eichholtz et al.,2015).

This trend comes with the risk of losing customers and brand integrity when retailers are just marketing and not acting on core values, thereby affecting their performance (Syntrus, 2019; KMPG, 2020). The customers therefore prefer retailers who focus on a sustainable supply-chain and care for their workers, customers and surroundings. Ideally, more sustainable retailers could enhance the shopping experiences, help the branding of the location and improve relations with local actors resulting in attraction of customers thereby improving store performance. Therefore, given these trends, it is relevant to research whether improvements in sustainability, especially with the broad perspective of the BREEAM label, would create a financially stronger Dutch retail real estate.

Throughout literature, tangible (financial) and intangible (behavioural and environmental) effects are found by studying the effects of sustainability labels on real estate. By attaining a sustainability label, real estate achieves benefits such as corporate image improvements (Arif et al, 2009; Serpel et al., 2013), improved tenant health, better wellbeing, longer lease agreements and higher satisfaction (Eichholtz, et al. 2015; Windapo & Goulding, 2015; Serpel et al., 2013), higher returns on investments (Pulselli et al, 2007; Devine & Kok, 2015; Low et al. 2014), the improved ability to attract premium clients and higher rental returns (Sayce et al. 2007; Devine & Kok, 2015), lower operating costs over time (Ahn et al, 2013; Vlasveld & Op't Veld, 2013) and more. These benefits are observed when comparing EPC, LEED or Energy-Star labelled real estate versus non-labelled peers.

Despite these positive effects, research utilizing the full potential of the broader perspective of BREEAM remains scarce, as this research is focused on the Dutch real estate markets, hence making interpretations of previous results not always straightforward. Most of the literature is targeting Energy-Star and LEED regarding the US office and housing markets due to the vast amount of available data (Vlasveld & Op't Veld, 2013). In addition, the UK has been a favoured location for studies with a focus on office markets and the effects of LEED and EPC (Fuerst & McAllister, 2011; Eichholtz et al, 2013; Chegut, et al, 2014, 2017). Studies on sustainability and its effects on financial performance of Dutch real estate markets, although becoming more frequent (Kok & Jennen, 2012; Vlasveld & Op't Veld, 2013; ING REF & University of Maastricht, 2017), are still limited and predominantly focused on office real estate. Academic research on BREEAM is scarce despite increasing popularity of its application in The Netherlands (annually doubling the amount of certification (BREEAM, 2020)). The uncertainty of positive outcomes associated with investments in sustainability is therefore not fully explainable (Op't Veld & Vlasvled, 2013; Leskinen et al. 2020).

This paper aims to contribute to the understanding of sustainability labels and adds to current literature by focusing on the associated effects on Dutch retail real estate. In existing literature, sustainability is generally measured by labels that are not represented in the Netherlands and predominantly focused on the US and UK office sector (Eichholtz et al., 2010; Fuerst & McAllister, 2011; Kok & Jennen, 2012; Chegut et al, 2014; Devine & Kok, 2015). It could be questioned whether the observed effects for the office sector can be directed towards the retail sector, since the latter is far more customer driven (Op 't Veld & Vlasveld, 2013). Meaning the impact of sustainability labels influences the customer shopping experience and spending behaviour far more than the office sector. Moreover, the Netherlands outperforms the US and the UK in Environmental and Social Governance (ESG) ratings, indicating the Netherlands to be a more attractive country for sustainable real estate investments (Bouwinvest, 2020; Lopez-De-Silanes, 2020). This further suggests potentially different results for the Dutch retail real estate market and related institutional investors compared to the results for the US and UK markets.

With the above in mind, an additional interpretation of the underrepresented sustainability label BREEAM could help Dutch retail investors and tenants to support decision-making regarding their properties' sustainability and profitability. BREEAM provides a more detailed insight in possible improvements in current real estate, rather than just presenting the energy consumption. In addition, the focus of this paper is on the gross rental yield (GRY) of properties since investors use this as prime performance indicator regarding a buildings' capital value (McGarth, 2013; Colliers International, 2019). In contrast with most studies, that focus on rents and sales prices, the GRY reflects the expectation that the market value of a property will change over time. This implies, that lower GRY would indicate a less perceived investment risk, reflecting an increased demand or higher expected income growth (McGarth, 2013).

In this paper, the focus is on the effect of either a relative BREEAM score or a higher certification (more BREEAM Stars) on the financial performance of Dutch retail real estate. First, the literature is reviewed on the tangible and intangible effects of various sustainability labels on real estate. Second, by using actual portfolio data from a retail real estate investor, the strength and nature of the relationship between the GRY and BREEAM is investigated through the design and application of hedonic regression models. Finally, the effects of BREEAM scores (either relative scores or number of Stars) on two different types of retail real estate, being either Comparison buildings (non-daily shopping) or Convenience buildings (daily shopping), are studied.

The results from the applied hedonic pricing model indicate that an increase in BREEAM score would have a positive impact on the financial performance of retail real estate in the Netherlands, while controlling for building-, location-, and municipality characteristics. Additional results indicate financial premiums for Convenience buildings, relative to Comparison buildings.

The remainder of his paper is structured as follows. Chapter two explains the mechanism of sustainability labels of which BREEAM is highlighted. Chapter three concerns the theoretical foundations of this research and describes the developed hypotheses. Chapter four elaborates on the methodology of the designed hedonic models. Chapter five gives an analysis of the obtained dataset containing descriptive statistics and relevant figures. In chapter six the results are given and thereafter discussed and concluded in chapter seven.

2. BREEAM, A KEY SUSTAINABILITY LABEL

A broad variety of sustainability labels is in use, they can be divided into two categories. The first category relies on stating the energy efficiency through labels such as Energy-Star and EPC. The second category focuses on a broader interpretation of sustainability, examples are LEED and BREEAM.

In the first category of sustainability labels, Energy-Star is the US-government backed label for energy efficiency. Energy-Star works with a scale ranging from 1-100 (1 = very inefficient, 100 = very efficient) to provide simple, credible, and unbiased information (Devine & Kok, 2015; Energy Star, 2020). This label is applied to both consumer products and buildings. For buildings, a certification is obtained if the Energy-Star score is equal to or higher than 75% of similar buildings nationwide. In terms of energy consumption, an Energy-Star certified building uses on average 35% less energy than its non-certified peers (Energy Star, 2020; Devine & Kok, 2015). The European EPC-label states the energy efficiency of buildings and products as well but uses a different methodology. EPC, generally known in The Netherlands as 'energy-label', states multiple categories of energy efficiency along a scale of 0 to 2 (0 = very efficient, 2 = very inefficient). EPC is commonly represented in categories ranging alphabetically from A, meaning a score of 0, to G meaning a score of 2, respectively representing exceptionally high energy efficiency to exceedingly low energy efficiency. Energy efficiency is but a single aspect of sustainability.

The second category of sustainability levels aims to cover a more complete representation of the sustainability of a building, and to that extent LEED and BREEAM were introduced in 1993 and 1990, respectively. LEED and BREEAM are comparable in output, both stating the environmental sustainability in the design, construction, operation, and demolition of buildings, represented in an aggregated score. Both labels are based on an assessment of buildings recognizing and reflecting the sustainability across its lifecycle (Chegut et al. 2014; BREEAM, 2020). LEED originates from the US while BREEAM originates from the UK. LEED is mainly applied in the US on its own, however the label is gaining influence throughout the world (Zuo & Zhao, 2014). BREEAM has been more present worldwide (Zuo & Zhao, 2015; Eichholtz et al., 2015). LEED and BREEAM labels both represent aggregated scores from multiple categories of sustainability. In this paper, the categories of BREEAM are discussed, being comparable to LEED.

BREEAM was first developed in the 1990s in the UK and is now implemented across the world. Both social and environmental topics of a building are assessed. The aggregated score is calculated by weighted scores in eight different sustainability aspects and represented in a simplified way in figure 1 of Appendix A. Each aspect has a specific weight (the relative weight as percentage of the total 100%); energy (26.5%), health (17%), pollution (14%). transport (11.5%), land-use and ecology (9.5%), materials (8.5%), water (8%) and waste (5%). Each aspect is based on a variety of sub credits. The associated weights of the aspects are based on an international expert panel used by BREEAM and credited by a BREEAM-assessor (BREEAM, 2016). This expert panel bases the weights on consensus and societal trends, rather than scientific means, indicating the subjective nature of this label (BREEAM, 2016). When all aspect scores are accumulated, the total BREEAM-rating is represented on a scale ranging from 0-100 which is described and classified in Table 1. Worldwide there are multiple variants of BREEAM, based on current legislation and procedures per country (BREEAM, 2020). The Dutch version, BREEAM-NL, exists since 2009. BREEAM-NL is a governmentally accepted sustainability label and an official alternative to the well-known EPC. Currently there are 1370 certified projects, including 428 retail buildings, in the Netherlands (BREEAM, 2020). Having a BREEAM-labelled building can be useful when applying for subsidies regarding physical improvements for real estate (ROV, 2020). Since this study is focusing on Dutch real estate, the latest version of 'BREEAM-NL In-Use Asset' variant is used. It is the embodiment of the sustainable performance of a property in current use in The Netherlands and will be referred to as BREEAM in the remainder of this paper.

Table 1
Classification categories for BREEAM-NL In-Use Asset (BREEAM, 2016)

Number of Stars	Range of BREEAM score	Classification name
-	0% - 24.99%	No star
*	25% - 39.99%	Pass
**	40% - 54.99%	Good
***	55% - 69.99%	Very Good
****	70% - 84.99%	Excellent
*****	85% - 100%	Outstanding

3. THEORETICAL FRAMEWORK

Beneficial effects of sustainability labels have been found for both the amount of rent and the market value when labels are applied to real estate. Case studies on these benefits have been available since the early 2000s. However, these initial studies were casuistic and could not be generalized.

Miller et al. (2008) were among the first who empirically researched the benefits of investing in energy savings and environmental design in a broader perspective. Miller et al. (2008) used a hedonic pricing method to compare 643 Energy-Star and LEED rated office properties in the US to a control group, in order to determine the effect of these labels on occupancy rates, rental rates, sales prices and operating costs. The 'green' offices in this research had an Energy-Star label and LEED certification, but no further distinction was made between different levels. Therefore, in that study offices had obtained either a label or not. Focusing on the mean market price per square foot, when controlled for age, location and time, they were able to state a 10% higher sales price for LEED-labelled properties and a 5.76% higher sales prices for Energy-Star-labelled properties, when compared to the control sample respectively. Miller et al. (2008) suggests further research on different levels of certification could uncover the possible gains from attaining better certification.

Using a hedonic pricing method on US office real estate data, Eichholtz et al. (2010) build on the research of Miller et al (2008) by increasing the sample size and further exploring the effects of locational variables. Eichholtz et al. (2010) wanted to test whether the rent, effective rent and selling price was affected by the presence of sustainability labels while controlling for building characteristics such as age, size and height and location. A hedonic pricing method was used on a sample of 8105 'green' office buildings in the US, either labelled LEED or Energy-Star, relative to a control group. The study states statistically significant results of a 2% higher rent, 6% higher effective rent[1] and a 16% premium on market values (transaction prices). After sensitivity analyses, the results indicate that a sustainability label adds more value in smaller markets, regions and in the peripheral parts of more metropolitan areas, where the locational rents are lower.

There are various tangible and intangible effects that make investors choose for sustainable real estate. Despite the cost of attaining a sustainability label, according to Fuerst & McAllister (2011) investors benefit from reduced holding costs, reduced operational costs, reduced depreciation, and reduced regulatory risks, besides the mentioned rental and market value premiums. Eichholtz et al. (2013) stated that the lower risk premium associated with labelled buildings is already valued highly by investors, further suggesting this could indicate the robustness of labelled buildings in times of increasing energy prices. Hence, the investments in sustainable real estate create a way of insurance for the investors. In addition, banks and private equity firms view sustainable real estate as a means for risk-

[1] Rent is fairly static within a given period of time, the effective rent however includes including incentives/concessions and consideration of rent-free periods and is hence averaged out over the term of the lease, (McGrath, 2013; Chegut et al., 2014). However, in the study of Eichholtz et al. (2010) the effective rent is stated as the rent multiplied by the occupancy rate.

mitigation (Eichholtz et al. 2013). Besides limited risks, there are more benefits of having sustainability-labelled real estate in comparison to non-labelled real estate. If future legislation is changing and becoming stricter with regards to sustainability requirements, the exit yield might be improved for labelled real estate in contrast to non-future-proof real estate. Miller & Garber (2013) and Eichholtz et al. (2010) state that large financial payoffs for investors can be achieved in energy usage, especially with increasing pressure regarding certification, aimed at controlling global warming.

To support the investors perspective towards sustainable real estate, McGrath (2013) builds on the current hypotheses and research by examining the effects of different categories in LEED certification on excess capitalization rates (cap rates) based on US office data. It was expected that anticipated future benefits associated with the criteria regarding LEED certification would achieve lower cap rates than their non-labelled peers in the period of 2002 to 2010. By using a hedonic model on 375 office buildings, of which 25 are LEED certified, the hypothesis was supported by achieving 0.364 reduction in excess capitalisation rates in case a label was obtained. However, no conclusive results were obtained when the LEED-certification was ordered into different performance levels, which is primarily suggested to be caused by the very small amount of LEED observations. The question arises whether it is still beneficial to create sustainable buildings even if the willingness to pay for sustainability becomes lower for tenants. Miller et al. (2008) and KPMG (2020) conclude that the investor has more opportunities to choose tenants driven by increased awareness of the importance of sustainability, therefore the investor takes advantage through faster absorption.

Devine & Kok (2015) further explore the tenant perspective towards sustainable real estate and its (in)tangible effects on tenant performance. Devine & Kok (2015) focused on the effect of LEED certification by studying the likelihood of lease renewal, tenant satisfaction and utility consumption during the period of 2004 to 2013. By using a hedonic pricing method on about 300 certified buildings, Devine & Kok (2015) find significant results suggesting that the impact of green building certification increases the likelihood of lease renewal. This would suggest that the financial stability is increased by limiting release costs. These costs include both broker commissions and tenant buildout, even limiting the exposure to periods of higher vacancy. The impact of sustainability labels significantly increases the tenant satisfaction by about 6%. In terms of utility consumption, Devine & Kok (2015) find significant results for power usage, stating a 14% reduction for LEED-certified buildings, while finding insignificant results for water consumption. Although this research offers insights in the intangible effects of sustainability labels on office markets, the research is conducted on a relatively small dataset of 300 samples. In addition, the tenant data are based on a biannual tenant-level survey, being aggregated into property-level data without further clarification on the process. This could imply a bias via group correlations or interaction, both not addressed in the article.

Most significant findings regard EPC, Energy-Star or LEED and are therefore based on the US office sector, making the conclusions less suitable to be generalized globally and towards the European and the Dutch real estate market (Kok & Jennen, 2012). However, over time there appears to be a shift in focus, where the UK seems to be most prominent within the European academic literature. Fuerst & McAllister (2011) are among the first to examine whether EPC would have a positive effect on different types of real estate in the UK, more specifically London. No evidence of a strong relationship between environmental and/or energy performance and rental and market values was found in either retail, office, or industrial real estate. The lack of statistical significance has been attributed primarily to the small sample size of 708 observations in total. In addition, the fact that regardless of the potential cost savings, tenants might be less concerned with the energy consumption for they merely 'use' the space, rather than own it. Despite the statistically insignificant results, this paper sparked more widespread research in Europe. Additional studies in the UK found rental premiums for EPC labels on offices (Fuerst & Weteringe, 2013), lower risk of (future) vacancy (Falkenbach et al., 2010) and lower operating costs (Ahn et al., 2013).

The first study based on the effects of the superior BREEAM label was also performed in the UK. Chegut et al. (2014), used data of over 2000 offices between the years 2000 and 2009 to research whether BREEAM would affect office rents and sales prices in a similar manner as EPC and LEED. They found an 19.7% rent and 14.7% sales premium for BREEAM-labelled offices relative to non-labelled peers. Fuerst & Weteringe (2015) explored BREEAM even further, by focusing on offices located in the UK and the building-stock fluctuations over time between 2007 and 2010. Subsequently the relative accessibility of these offices was considered. They found that BREEAM labelled buildings, disregarding the height of the score of the label, provided 28% to 30% rental premiums between the period of 2007 to 2010. Despite the 'positive' rental premiums, the effect of BREEAM became weaker over time as more properties are becoming labelled. This suggests that early adopters of sustainability labels reap most benefits in their current surroundings. However, the broader perspective BREEAM offers is somewhat neglected by focusing on either having a label or not, rather than taking into consideration what drives this effect. The effect could be generated by any, or a combination, of the eight aspects of BREEAM. It would therefore be relevant to see whether different levels of that BREEAM affect these financial performance indicators differently and whether these effects can be traced back to the related aspect.

Academic research regarding the Dutch real estate market is still limited, merely focused on the effects of EPC-labelling and troubled by the data limitations in the different real estate sectors besides the office-sector. The focus on EPC is persistent in literature, since the implementation of results is relatively easy, being narrowed down to energy efficiency instead of the broader perspective of BREEAM (Kok & Jennen, 2012).

Kok & Jennen (2012) used data of 1256 Dutch offices, from the three largest real estate agents in the Netherlands, to address this literature gap, offering systematic insight in the effect of sustainability on the European office market. They evaluate the financial implications of energy efficiency through EPC-labelling and accessibility. While correcting for the most commonly used value drivers, being age, location and size, they find that rents of Dutch 'non-green', 'energy-inefficient' offices, labelled EPC-label D or lower, have 6% lower rental levels compared to 'green', 'energy-efficient' offices, labelled C or higher. The study started a stepwise development in the valuation process of Dutch properties since it then became clear that less sustainable properties meant less income, meaning less market value. The credit risk can also be affected by these lesser values, leading to a higher loan to value ratio.

With the intent to find comparable results for the Dutch retail sector, Op't Veld & Vlasveld (2013) investigated the retail sector and the effects of EPC on its financial performance. The study focused on the effects of EPC on rent, sales price, vacancy, and operating costs of a retail portfolio between 2007 and 2011. Using a hedonic regression, no statistically significant results were found, which they attributed to the small sample size of about 130 retail properties. Another unmentioned reason could be the way how they had defined retail. Since there are various types of retail, such as standalone highstreet stores, supermarkets and shopping malls, the results could be heavily influenced in case these are put together, as was done in this research. Nevertheless, rent, and market value, of a retail unit is probably predominantly determined by more intangible effects, such as the potential sales of a retailer in a specific unit at a specific location, rather than its energy performance (Kok & Jennen 2012; Op't Veld & Vlasveld, 2013). This implies that a retailer is more likely to invest in improved lighting, to better lit his products, rather than to lower energy costs. This suggests that a retailer is willing to accept higher energy costs if these drive a higher profit due to increased sales.

This paper builds on earlier research in three ways. First, the focus on Dutch real estate adds to the results of existing research predominantly focused on US and UK real estate markets. Second, this paper investigates the effects of relative BREEAM-scores therefore adding to current literature, currently reporting on the effects whether real estate is labelled or not. Since BREEAM is an aggregated percentage of multiple aspects of sustainability, this approach could give additional insight in intangible effects for investors and tenants. Third, this paper focuses explicitly on the retail sector, while current papers on the retail market are scarce in global academic literature.

Four hypotheses are derived, based on current literature. The first hypothesis states that there exists a financial premium on retail properties having a BREEAM label, meaning having obtained any number of Stars compared to having No Stars. This hypothesis is based on results found in previous literature stipulating benefits to having a sustainability label relative to having none (Chegut et al., 2014; Fuerst & Weteringe, 2015). It is expected that the GRY will be lower for buildings having either a 1 Star or 2 Star label relative to No Stars. The second hypothesis states that the GRY decreases in case the BREEAM score increases. Since benefit seeking investors could consider slight changes in the makeup of a building, thereby initiating an increase in BREEAM score, the GRY is to lower as is in correspondence with studies using EPC scores (Fuerst & McAllister, 2011; Kok & Jennen, 2012; Fuerst & Weteringe, 2013). The third hypothesis states that more obtained BREEAM Stars are reflected in a stronger decrease in GRY, as was hypothesised in the research of McGrath (2013) who uses LEED as sustainability label. The fourth hypothesis states that two different types of retail real estate, Comparison (Non-Daily shopping)and Convenience (Daily shopping), are affected differently by BREEAM. Since

Op’t Veld & Vlasveld (2013) suggest that different sizes of catchment area can influence the financial performance, a split has been made between Convenience and Comparison. Convenience retail is often more associated with a more local function than Comparison, for which customers may be willing to travel a greater distance (Fuerst & Wetering, 2015).

4. DATA

To test the hypotheses empirically, information was collected from retail real estate that had received a BREEAM score. The dataset, used in this study, contains retail real estate data provided by Altera, a retail real estate investor. Its financial values are based on fourth quarter valuations in the year 2019. The initial database consists of 92 buildings at 40 different locations, including data on the majority of individual stores[2] inside these buildings. Figure 3 illustrates an example of five buildings at one location indicating rather heterogeneous buildings in terms of scale. Figure 4 represents the locations of all buildings. All buildings have been BREEAM-certified[3], therefore representing over 21% of the total 428 certified retail-buildings in the Netherlands (BREEAM, 2020).

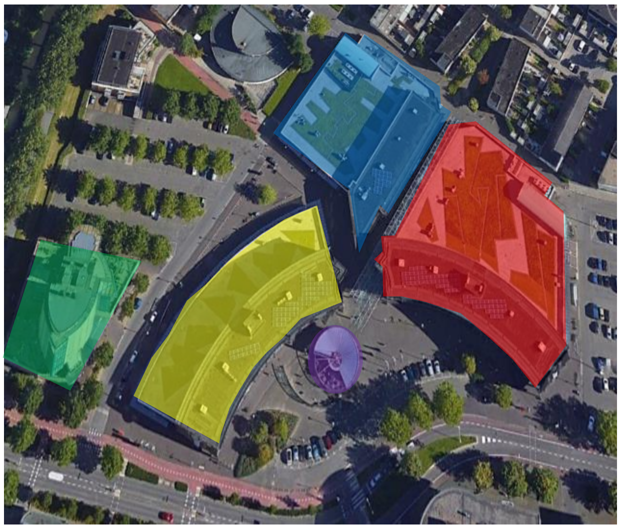


Figure 3: Illustration of five Convenience buildings at one location (Dordrecht), presented in coloured surfaces, each having a single BREEAM score

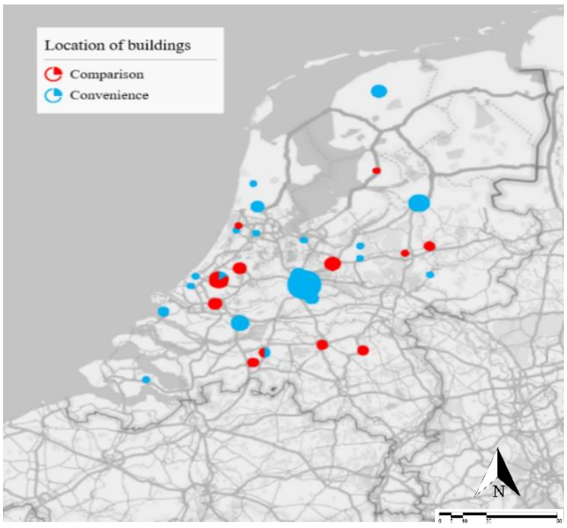


Figure 4: Representation of the location of Comparison- and Convenience buildings. The size of the circles indicates how many buildings are situated on a single location, not the size of the building itself

4.1 Key variables

The GRY is a measure to value the risk and potential of a real estate investment, reflecting the assumptions of investors (Tsolacos et al. 1998; Fuerst & McAllister, 2011; McGrath, 2013; Feige et al. 2013). Sometimes in literature, the GRY is referred to as gross initial yield, although not exactly equivalent (gross initial yield is in fact the first year GRY (Colliers International, 2019). The GRY is the result of dividing the annual rent by the investment costs (or current market value) reflecting the investor's assumptions for future return growth or reduced risk (McGrath, 2013). Contrary to McGrath (2013), this research does not use capitalisation rates (cap rates) for only the gross annual rent is provided in the database, therefore neglecting possible operating costs and other expenses necessary to attain the net operating income, thus the cap rate. Nevertheless, the same principle regarding cap rates holds true

---

[2] This research focuses on buildings rather than individual stores

[3] The entire Altera portfolio was BREEAM-certified at a single point in time. Therefore, this research is limited to the financial status of the buildings in year 2019, as BREEAM scores were only then obtained, thus not supporting panel data.

for GRY, meaning that a lower GRY would typically indicate less perceived investment risk, thereby reflecting the demand or higher expected income growth rates (McGrath, 2013). This research focusses on GRY rather than market value, rents or operating costs as individual indicators for they are all incorporated and taken into account in the GRY.

The Altera dataset provided the rents and market values of the individual stores, while also providing BREEAM scores for the buildings. In addition, the GRY was initially provided at locational level, meaning the average of the multiple BREEAM labelled buildings (at one location), however this needed to be transformed. All gross annual rents and current market values of stores were present in the provided dataset. By applying the methodology of McGrath (2013) and Colliers International (2019), the total of all gross annual rents of all individual stores inside a building is divided by the total market value of these stores. This results in 92 GRYs on building level, meaning each building in the dataset obtained an individual GRY.

Three buildings are excluded from the dataset, resulting in a final dataset of 89 buildings. One building had a BREEAM-score of 82% making it the only 4 Star building in the dataset. To provide conclusive results, this building was signalled as outlier since all other buildings either had 0, 1 or 2 Stars. A second building was removed, for it missed appropriate data needed to calculate the GRY. The third BREEAM labelled building was removed for representing ‘Specialised’ retail real estate and therefore out of the scope of this research.

4.2 Control variables

The control variables include net leasable floor area (NLFA), age (Age), occupancy rate (OR), Walk-Score(WS), urbanity index-dummies (VHU, HU, MoU, MiU, NU), average income per household (AI) and average distance to highway entries (AdH) and train stations (AvT). The control variables can be clustered in three groups, called Building-, Location- and Municipality Characteristics.

Building Characteristics include three control variables, 1) Net leasable floor area, 2) age and 3) occupancy rate of the building, all present in the dataset of Altera. Size of the building was provided in the Altera dataset and is used as control variable, as done by Kok & Jennen (2012), Eichholtz et al. (2013), Chegut et al. (2014) and others. In this research, size is expressed as the Net Leasable Floor Area in square meters (NFLA). Age is used as done by Fuerst & McAllister (2011), Chegut et al. (2014), Op’t Veld & Vlasvled (2013), and others. Age is defined in number of years, being the result of the year 2019 minus year of construction. Occupancy rate is suggested as determinant for financial performance by Fuerst & McAllister (2011), Eichholtz et al. (2013), Devine & Kok (2015) and others. Occupancy rate was derived by inversing the provided Vacancy rate, ranging between 0 to 100 .

Location Characteristics include the Walk Score and the urbanity index. The Walk Score was obtained through the Walk Score database organised by for the street name. The Walk(ability) Score is in line with Pivo & Fisher (2011), Kok & Jennen (2012) and Op’t Veld & Vlasvled (2013). To include the walkability towards amenities is embedded in the urbanization of economies (Kok & Jennen, 2012).

This walkability score is represented in a scale from 1 up to 100 percentage points, where 1 means complete car-dependence and 100 means walkable for daily errands. As proven by Pivo and Fisher (2011) the walkability of places is value enhancing for retail, office, and industrial properties in the US. Limitations of the Walk Score, as an indicator, are the negligence of physical barriers or connectivity, all types of destinations are weighted equally, and it is based on US standards. The urbanity index is added since Nanthakumaran et al. (2000) and Lazrak (2014) state that population density affects real estate value. Data were initially provided as number of inhabitants living in separate categories of urbanity. Five dummies are created representing five classes of population density. The five classes range from 'Very Highly Urban'(VHU) to 'Not Urban'(NU) as defined by Central Bureau of Statistics (2020). 'Very Highly Urban' has an address-density above 2500 inhabitants per square kilometre while 'Not urban' has an address-density lower than 500 per square kilometer.

Municipal Characteristics include average income per household and distances towards highway entries and train stations. Kumar & Karande (2000) suggest that the income of households surrounding retail real estate affects retail financial performance. Therefore, on municipal level, the income per household is added and represented in euros. The average income per household was obtained from Central Bureau of Statistics (2020) and divided by 1000 to make interpretating the results easier. Younger et al. (2008), Kok & Jennen (2012) and Op't Veld & Vlasveld (2013) include distance towards highway entries and train stations to research if these local transport networks influence office and retail performance. The distance to highway entries and train stations has been added as average kilometer per municipality. Since retail real estate in general provides a direct catchment area it is not deemed useful to check the individual distances. The distance is based on municipal level to generalise for retail real estate, either being in well-connected or poorly connected municipalities.

There are five assumptions to be met when applying a multiple regression analysis, which will be further discussed in the Methodology (Chapter 5). However, given the nature of this chapter, the first assumption is examined here, concerning variables that need to be normally distributed. Normality of variables was tested resulting in four transformations. Net leasable floor area, age and standardized income per household were transformed using the natural logarithm to reduce heteroskedasticity and decrease the risk of an inefficient model (Brooks & Tsolacos, 2010). The urbanity index was initially provided in terms of five amounts of inhabitants per type of urban density. To properly implement in the models, they are transformed into five dummies for better interpretation. The five dummies represent the address-density of inhabitants per square kilometer taking the value of 1 when in a specific density range and 0 if otherwise.

4.3 Descriptive statistics

The characteristics of the sample of retail buildings are shown in Table 2, stating the number of observations, mean, standard deviation, minimum and maximum of each variable. In Table 2 the GRY is 7,05% on average, which is in line with the reported GRY of 7.5% by Syntrus Achmea (2019) on all retail establishments in the Netherlands. A mean BREEAM score of 29.89% is represented in the dataset, meaning that on average the buildings have obtained 1 Star. Further elaborate descriptions of the data are provided in Table 3, where the dataset is ordered reflecting the number of obtained Stars.

Table 2
Descriptive statistics of the used dataset

Group	Variable	Obs.	Mean	Std. Dev.	Min	Max
Main dep. variable	Gross Rental Yield (GRY)	89	7.05	0.99	4.71	9.40
Main indep. variable	BREEAM score (BREEAM)	89	29.89	8.16	18.69	49.89
Building characteristics	Net leasable floor area (NLFA)	89	2128.36	2755.55	68	16884.20
	Occupancy rate (OR)	89	92.00	15.82	0	100
	Age (Age)	89	34.43	24.41	9	129
Locational characteristics	Walkscore (WS)	89	87.02	10.55	60	99
	Very highly urban (VHU)	89	0.25	0.43	0	1
	Highly urban (HU)	89	0.65	0.48	0	1
	Moderately urban (MoU)	89	0.04	0.21	0	1
	Mildly urban (MiU)	89	0.03	0.18	0	1
	Not urban (NU)	89	0.02	0.15	0	1
Municipal characteristics	Average income per household (AI)	89	30.89	3.19	25.5	41.1
	Distance to highway entry (AdH)	89	1.84	0.41	0.8	3
	Distance to train station (AdT)	89	4.18	4.78	1.7	27.8

Table 3 presents the descriptive statistics of the dataset ordered to the number of obtained Stars[4]. The GRY shifts among the groups stating 7.09, 7.21 and 6.41 for No Stars, 1 Star and 2 Stars, respectively. Here a preliminary conclusion could be drawn that 2 Star buildings achieve a better GRY than the other groups. One of the possible explanations for achieving a better GRY is that these buildings are situated in more densely populated areas and have less vacancies. Another explanation could be that these properties are better accessible to the public by car, which could indicate that these larger retail buildings could have a larger catchment area. The 32 'No Star' buildings are smaller, and somewhat older compared to the 44 '1 Star' buildings and 13 '2 Star' buildings.

[4] All buildings went through the labelling process. A 'No Star' label, although a low score, still represents a BREEAM label.

Table 3
Descriptive statistics of groups and the amounted of obtained stars

	GRY	NLFA	Age	OR	WS	VHU	HU	MoU	MiU	NU	AI	AdH	AdT
No Stars													
Mean	7.09	1413.38	36.75	91.37	86.16	0.19	0.72	0.06	0.03	0.00	31.77	1.93	3.11
Std. Dev.	1.08	1657.77	25.82	12.90	12.36	0.40	0.46	0.25	0.18	0.00	3.03	0.42	2.14
Min	4.71	68	9	60	60	0	0	0	0	0	25.5	0.8	1.7
Max	9.40	9124.9	129	100	99	1	1	1	1	0	39.5	2.3	10.2
Obs.	32	32	32	32	32	32	32	32	32	32	32	32	32
1 Star													
Mean	7.21	2392.16	32.91	90.36	88.86	0.23	0.66	0.05	0.02	0.05	30.48	1.81	4.66
Std. Dev.	0.99	2915.21	23.00	19.27	8.71	0.42	0.48	0.21	0.15	0.21	3.23	0.40	5.40
Min	5.24	134.76	9	0	72	0	0	0	0	0	25.5	0.9	1.8
Max	9.13	16884.20	127	100	99	1	1	1	1	1	41.1	2.5	27.8
Obs.	44	44	44	44	44	44	44	44	44	44	44	44	44
2 Stars													
Mean	6.41	2995.49	33.85	99.15	82.92	0.46	0.46	0.00	0.08	0.00	30.12	1.71	5.22
Std. Dev.	0.43	3961.95	27.00	3.08	10.79	0.52	0.52	0.00	0.28	0.00	3.19	0.40	6.84
Min	5.91	874.15	19	88.89	70	0	0	0	0	0	28.1	1.5	1.8
Max	7.5	15903.16	119	100	95	1	1	0	1	0	38.1	3	27.8
Obs	13	13	13	13	13	13	13	13	13	13	13	13	13

Table 4 shows the descriptive statistics based on the types of retail real estate, following the definition of Convenience and Comparison, as stated by Altera. Buildings are labelled according to the function of the majority of the individual retail units. Hence a building is either called Convenience (merely food orientated, called daily shopping) or Comparison (Non-food orientated, called non-daily shopping) in case the majority of the individual retail units reflects either Convenience or Comparison. Further explanation is provided in Methodology (Chapter 5). The GRY of Convenience buildings is lower and has a lower standard deviation, relative to Comparison buildings. An explanation for that could be the trend of Convenience buildings outperforming Comparison buildings in recent years in terms of increased sales indicating a higher market value (Syntrus Achmea, 2019). Age could be another explanation for this difference in average operating costs; costs of heating installations are lower than those of Comparison buildings since Convenience buildings are constructed following more recent heat-preserving guidelines for isolation.

Table 4
Descriptive statistics based on types of retail real estate

	GRY	BREEAM score	NLFA	Age	OR	WS	VHU	HU	MoU	MiU	NU	AI	AdH	AdT
Comparison														
Mean	7.27	27.43	2635	45.67	91.51	96.37	0.33	0.56	0.07	0	0.04	29.81	1.82	4.79
Std. Dev.	1.29	4.88	3742	36.75	14.28	2.78	0.48	0.51	0.27	0	0.19	1.65	0.35	5.02
Min	4.71	20.21	68	10	50	86	0	0	0	0	0	26.2	1.1	2
Max	9.40	38.01	16884	129	100	99	1	1	1	0	1	31.5	2.5	22.7
Obs.	27	27	27	27	27	27	27	27	27	27	27	27	27	27
Convenience														
Mean	6.96	30.80	1678	29.38	92.09	83.10	0.20	0.70	0.03	0.05	0.02	31.41	1.85	3.91
Std. Dev.	0.83	9.04	1258	14.34	16.67	10.10	0.40	0.46	0.18	0.22	0.13	3.58	0.44	4.74
Min	5.84	18.69	103	9	0	60	0	0	0	0	0	25.5	0.8	1.7
Max	9.13	49.89	8210	119	100	96	1	1	1	1	1	41.1	3	27.8
Obs.	62	62	62	62	62	62	62	62	62	62	62	62	62	62

5. METHODOLOGY

To analyse obtained data and to explain the effects of BREEAM on the gross rental yield (GRY) of retail real estate, multivariate Ordinary Least Squares (OLS) regression is applied[5]. A specific OLS regression method, the hedonic pricing method, is applied as initially proposed by Rosen (1974), based on the consumer theory of Lancaster (1966). The hedonic pricing method models the financial performance of a property influences by individual characteristics.

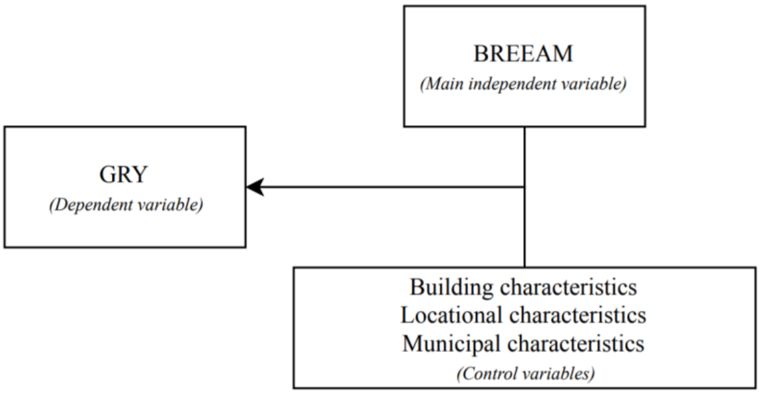


Figure 2: Conceptual model

Based on Rosen (1974), a hedonic pricing model is designed and applied to research the expected relations, based on literature, between the GRY with the independent variable BREEAM and control variables, represented in the conceptual model in figure 2. Four models are designed to test the four hypotheses, respectively. The first model reflects the effect of an obtained BREEAM label, indicating any amount of obtained Stars excluding No Stars. The second model describes the effect of BREEAM as a relative score. The third model states the effect of different numbers of obtained Stars. The fourth model specifies the effect of BREEAM on two different types of retail real estate.

The first model builds on the main models of Kok & Jennen (2012), McGrath (2013), Op't Veld & Vlasveld (2013), Chegut et al. (2014) and Devine & Kok (2015), tests the first hypothesis and is represented as:

$$GRY_j = \alpha + \beta B_j + \sum_{k=1}^{K} \gamma_k BC_{kj} + \sum_{l=1}^{L} \delta_l LC_{lj} + \sum_{m=1}^{M} \theta_m MC_{mj} + \varepsilon_j \qquad (1)$$

[5] According to Brooks & Tsolacos (2010) five assumptions need to be met to correctly interpret results of OLS regressions. The five assumptions are discussed, tested and fulfilled in APPENDIX C, are: 1) the errors have a zero mean, 2) homoscedasticity is confirmed, meaning the variance of errors is constant and finite, 3) the errors are statistically independent of one another, 4) no multicollinearity is found, meaning there is no relationship between the error and corresponding variables, 5) normality of residuals is confirmed. If all assumptions hold, a Best Linear Unbiased Estimator (BLUE) is constructed, meaning the OLS estimator can be shown to be consistent, unbiased, and efficient (Brooks & Tsolacos, 2010).

Where GRY_j is the Gross Rental Yield of property j; α is the constant; β , γ_k , δ_l , θ_m are parameters to be estimated; B_j is a dummy taking the value of 1 if a BREEAM label is obtained and 0 if not, for property j; BC_{kj} is the vector of Building Characteristics K of property j, where k = 1 represents size, k = 2 represents age and k = 3 represents occupancy-rate; LC_{lj} is the vector of Location Characteristics L of property j, where l = 1 represents Walk Score and l = 2 represents urbanity index; MC_{mj} is the vector of Municipal Characteristics M of property j, where m = 1 represents the income per household, m = 2 represents average distance towards highway entry and m = 3 represents average distance towards a train station; ε_i is the stochastic error term.

The second model tests the second hypothesis by examining the BREEAM score, and is represented as:

$$GRY_j = \alpha + \beta Bscore_j + \sum_{k=1}^{K} \gamma_k BC_{kj} + \sum_{l=1}^{L} \delta_l LC_{lj} + \sum_{m=1}^{M} \theta_m MC_{mj} + \varepsilon_j \qquad (2)$$

The second model is like the first model, besides changing B_j to $Bscore_j$. Where $Bscore_j$ is the relative BREEAM score.

The third model allows for studying the relation between different levels of BREEAM and GRY. In current business practice, BREEAM is described on a five-star scale rather than as a continuous value. BREEAM is presented in several achieved BREEAM-Stars, each representing percentage range. The percentage ranges and associated number of Stars are shown in Table 1, chapter 2. In line with McGrath (2013), to reflect the effect of obtaining more Stars and therefore be able to answer the third hypothesis, the following equation is designed:

$$GRY_j = \alpha + \sum_{h=1}^{H} \beta_h S_{jh} + \sum_{k=1}^{K} \gamma_k BC_{kj} + \sum_{l=1}^{L} \delta_l LC_{lj} + \sum_{m=1}^{M} \theta_m MC_{mj} + \varepsilon_j \qquad (3)$$

This third model is equal to the first model, besides changing B_j to S_{jh}. Where S_{jh} is the vector for number of obtained Stars S for property j, where h = 1 represents a dummy taking the value of 1 for 0 Stars, h = 2 represents a dummy taking the value of 1 for 1 Star and h = 3 represents a dummy taking the value of 1 for 2 Stars.

A complication that might occur is the misestimation of the affected financial performance of properties in the retail sector, due to the many different types of retail real estate that the sector includes (Op't Veld & Vlasveld, 2013; Fuerst & Weteringe, 2015). To further explore the relatively unresearched differences within retail in relation to sustainability labels a division is made in the dataset. These two divisions are Convenience buildings, providing daily consumer purchasing purposes and Comparison buildings, providing non-daily consumer purchasing purposes (Holton, 1958). Daily purchasing purposes are satisfied by stores selling goods that are frequently bought by consumers resembling (fast)food-, grocery- and therefore daily shopping stores. Non-Daily purchasing purposes are represented stores with less frequently bought goods resembles fun/experience-, fashion- and therefore non-daily shopping areas. Further subdivisions indicating different types of stores, such as supermarkets, shopping centres and standalone Highstreet stores, however the obtained data do not allow further segregation. Therefore, the focus is on either Convenience buildings or Comparison buildings.

The fourth model allows for studying the effect of different types of retail real estate, hence the fourth hypothesis, and is formulated as:

$$GRY_j = \alpha + \sum_{h=1}^{H} \beta_h S_{jh} + \sum_{k=1}^{K} \gamma_k BC_{kj} + \sum_{l=1}^{L} \delta_l LC_{lj} + \sum_{m=1}^{M} \theta_m MC_{mj} + \Phi RT_j + \varepsilon_j \quad (4)$$

The fourth model is similar to the previous models, adding RT_j. Here, RT_j is a dummy variable taking the value of 0 when studying Convenience buildings and 1 when studying Comparison properties for property j. The to be estimated parameter is Φ.

There are of course shortcomings to the use of the hedonic pricing method, two of these are discussed within the scope of this research. First, adjustment costs for construction improvements in properties can be high (Sopranzetti, 2010). When translated to this research, the expected positive effects of an increased BREEAM score on GRY can be overestimated since required investment costs are not included yet. Therefore, the conclusions, discussed in Chapter 7, should be interpreted bearing in mind the omitted investment costs. Second, omitted variable bias, occurs when relevant variables are excluded, as discussed by Chegut et al. (2019), Fuerst & McAllister (2011) and OECD (2013). In this paper, key variables that can be expected to affect the financial performance are included. Since it is practically impossible to include all possible variables expected to explain the financial performance, a selection is made based on relevance as occurring in literature.

Multiple statistical tests are performed to test the consistency and efficiency of the estimators. Among these are the graphicly interpreting P-P Plot, Q-Q plot, histograms and testing through Variance Inflation Factors (VIF), Breusch-Pagan / Cook-Weisberg test for heteroskedasticity and Shapiro-Wilk test. Results of these tests are discussed in detail in Appendix C. The conclusion is that the residuals are BLUE .

6. RESULTS

6.1 Testing the effect of an obtained BREEAM label

The regression results are shown in Table 5 where the first model analyses the effect of having a BREEAM label , meaning having obtained either 1 Star or 2 Stars, compared to having none. Every consecutive model, from model 1.1 onwards, reflects an addition of control variables. When adding control variables in an ordered manner, coefficients and signs vary just to a minor extent. First, model 1.1 shows the relationship between the key independent variable BREEAM and the dependent variable GRY. Second, model 1.2 adds the building characteristics. Next, model 1.3 adds the locational characteristics. Finally, model 1.4 adds the municipal characteristics controlling for the average income of households and distances towards transportation hubs (highway entries and train stations). Since model 1.4 adds all control variables and has the highest R-squared at 43.4%, meaning the highest fit, this model is used for further analysis. The regression results are shown in Table 5, and a version including p-values is presented in Appendix B.

Table 5
Regression results for Gross Rental Yield (GRY)

Indep. Var.	Model 1.1	Model 1.2	Model 1.3	Model 1.4
BREEAM Star	-0.068	-0.179	-0.270	-0.312
	(0.220)	(0.203)	(0.203)	(0.198)
Ln(NFLA)		0.170	0.202**	0.213**
		(0.072)	(0.093)	(0.086)
Ln(Age)		-0.359*	-0.557***	-0.622***
		(0.190)	(0.207)	(0.204)
OR		-0.023***	-0.024***	-0.019***
		(0.006)	(0.006)	(0.009)
WS			0.022**	0.017*
			(0.009)	(0.009)
VHU			-0.384	-0.365
			(0.656)	(0.658)
HU			-0.600	-0.334
			(0.6394)	(0.636)
MoU			0.131	0.351
			(0.799)	(0.757)
MiU			0.300	0.336
			(0.805)	(0.796)
Ln(AI)				-1.984***
				(1.051)
AdH				0.768**
				(0.249)
AdT				0.051***
				(0.025)
Constant	7.094***	9.320***	8.439***	13.574***
	(0.176)	(1.177)	(1.450)	(3.725)
Observations	89	89	89	89
R-squared	0.001	0.238	0.316	0.4338
adj. R-squared	-0.010	0.201	0.238	0.3444

Note: Dependent variable is GRY. Standard errors are in parentheses. BREEAM Star indicates having either 1 Star or 2 Stars for No Stars is the reference category. NU is omitted for being a reference dummy. *** p<0.01, **p<0.05, *p<0.1.

Table 5 presents a statistically insignificant result for GRY stating a decrease of 0.03 basepoints, when either a BREEAM label, represented by having either 1 Star or 2 Stars, is present compared to having no label, represented as having 0 stars. This suggests that having a BREEAM label is not a statistically significant determinant of the GRY. It can therefore be stated that the first null-hypothesis, indicating no difference in GRY between having a label or not, cannot be rejected. This means that the expected relation, indicating a financial premium for retail buildings by obtaining a BREEAM label, cannot be confirmed. The statistical insignificance is most likely due to the relative sample size of the control group. Controlling variables age, occupancy rate and distances towards highway entries are significant at the 1% level. Net leasable floor area and distance towards train stations are statistically significant at 5% and the Walk score and average income per household at 10%. Results for the urbanity index do not confirm common perception that location for real estate is key to the financial performance. Supporting the findings of (Eichholtz et al. 2016) the results show that the bigger, less accessible retail buildings obtain lower GRYs, relative to smaller, more accessible buildings, ceteris paribus. Plausible reason for this result could be that larger buildings, that take into account a larger catchment area, perform financially better, are benefitting of economies of scale and are preferred among investors (Kok & Jennen, 2012; Miller et al., 2008). Results are similar to the research of Kok & Jennen (2012) and Devine & Kok (2015), BREEAM-labelled buildings are younger, better occupied and located in wealthier areas, performing better than their older, vacant counterparts located in less wealthier areas. However, since there is no statistically significant result for attaining a BREEAM label, cautious interpretation is advised.

6.2 Testing the effect of an increased BREEAM score

The results of the second model, including all control variables, are presented in Table 6. A version including p-values is presented in Appendix B.

The second hypothesis is confirmed, since the null hypothesis, indicating an increase in The BREEAM score would increase the GRY, is rejected. In Table 6, BREEAM score is statistically significant at a 5% level, stating an increase in BREEAM score of 1 base point would results in a lower GRY by 0.024 base points, ceteris paribus. This result implies that there is a benefit to improve current retail real estate to obtain a higher BREEAM score, which is in line with earlier literature. Reason behind this decline in GRY could for instance be in terms of the energy efficiency or other intangible effects. Chegut et al. (2014) pointed out in their research that attaining a BREEAM label would result in increased rents, while Kok & Jennen (2012) named a potential saving in operating costs when a sustainability label was applied. This could mean that the potential increase in rents would be less strong than the increase in market value due to saved operating costs. Another explanation could be that a higher BREEAM score would result in higher tenant satisfaction or a more pleasant place to be, therefore resulting in higher sales.

Table 6
Regression results for Gross Rental Yield (GRY)

Indep. var.	Model 2
BREEAM score	-0.024**
	(0.012)
Ln(NLFA)	0.223**
	(0.085)
Ln(Age)	-0.610***
	(0.202)
OR	-0.019***
	(0.006)
WS	0.015*
	(0.009)
VHU	-0.209
	(0.656)
HU	-0.210
	(0.632)
MoU	0.400
	(0.748)
MiU	0.445
	(0.789)
Ln(AI)	-2.190**
	(1.055)
AdH	0.740***
	(0.247)
AdT	0.058**
	(0.026)
Constant	14.765***
	(3.797)
Observations	89
R-squared	0.441
adj. R-squared	0.353

Note: Dependent variable is GRY. Standard errors are in parentheses. NU is omitted for being a reference dummy. *** p<0.01, **p<0.05, *p<0.1.

McGrath (2013) explains that a LEED-certification, similar to BREEAM, targets all kinds of intangible effects, pointing to perceived declined risk for investors, therefore lowering GRY. Other intangible effects could be a higher retainment of tenants or higher attraction for customers to shop in more pleasant retail buildings. As BREEAM indicates a broad perspective of sustainability, a higher score could be realised though improvements in line with the aspects stated in figure 1 (Appendix A) and could for instance be; becoming more energy-efficient, adding more green roofing to the current retail building, improve ventilation systems, or improve water usage systems.

As before, control variables perform at similar significance levels when compared to the results in Table 5, except for average income per household which has increased statistical significance. Kok & Jennen (2012) mentioned that distances towards transportation hubs are seen as positive externalities for corporate office tenants, meaning that for every kilometer increase towards a hub, rent would decrease. A similar interpretation is possible in current results, suggesting a decrease in the GRY whenever the distance towards transportation hubs is decreased. This implies, a better-connected retail building would either result in a higher valuation of such a building, resulting in higher market value or a lower rent, therefore both decreasing the GRY.

6.3 Testing the effect of additional BREEAM Stars

The third model explores the third hypothesis stating the effect of different numbers of Stars on GRY and regression results are shown in Table 7. Despite obtaining a BREEAM label on its own does not decrease GRY, results shown for different numbers of obtained Stars indicate otherwise. Table 7 shows a statistically insignificant result for obtaining 1 Star 'Pass' compared to 0 Stars, though the direction of the effect is confirming the expected direction. Reason for this could be that 1 Star is not as strong of a financial indicator opposed to other variables. McGrath (2013) indicates similar results in terms of statistical significance, stating that the expected sign is realised however statistical significance is inconsistent among different certification levels of LEED. Despite using less classification categories than McGrath (2013), similar inconclusive are found her research. This might perhaps be due to the small amount of observations per classification, as McGrath (2013) indicated. Nevertheless, a statistically significant result for obtaining 2 Stars 'Good' is achieved. When compared to 0 Stars, a GRY reduction of 0.833 basepoints is achieved. As stated in the results of Table 5, this effect could be due to tangible effects, such as rent increase and operation costs decrease (Chegut et al.) or more intangible effects, such as higher retention rate due to improved tenant satisfaction, therefore indicating a lower risk (Devine & Kok, 2015).

It was expected that an increase in Stars would result in an increasingly stronger effect. The statistical significance needed to confirm the third hypothesis is not constant, despite confirming the expected sign of the relation, therefore a further interpretation of the effect of obtaining 1 Star, relative to 0 Stars, is not possible.

Table 7
Regression results for Gross Rental Yield (GRY) based on BREEAM Stars

Indep. var.	Model 3
1 Star (Pass)	-0.191
	(0.199)
2 Stars (Good)	-0.833***
	(0.289)
Ln(NLFA)	0.247***
	(0.085)
Ln(Age)	-0.575***
	(0.120)
OR	-0.017***
	(0.006)
WS	0.014
	(0.009)
VHU	-0.083
	(0.648)
HU	-0.147
	(0.621)
MoU	0.458
	(0.735)
MiU	0.553
	(0.777)
Ln(AI)	-1.956*
	(1.018)
AdH	0.736***
	(0.241)
AdT	0.054**
	(0.025)
Constant	13.031***
	(3.619)
Observations	89
R-squared	0.4746
adj. R-squared	0.3836

Note: Dependent variable is GRY. Standard errors are in parentheses. NU is omitted for being a reference dummy. *** p<0.01, **p<0.05, *p<0.1.

6.4 Testing the effect of BREEAM on different types of retail real estate

Table 8 represents the summarized regression results of the full fourth model where all control variables included. As stated before, the process of including control variables is stepwise, as is illustrated in Appendix B.

The fourth hypothesis, stating that the GRY of different types of retail real estate is affected differently by BREEAM certification, cannot be confirmed. Reason for this unconfirmed hypothesis is that results shown in Table 8 do not show consistent statistical significance. Table 8 states the effect of BREEAM score and the effect of having 1 or 2 Stars as opposed to 0 Stars. The R-squared for Comparison is deemed strong, for the model attains 81.5% and 82.3%, when looking at scores or number of obtained Stars. For Convenience, a moderately strong 54.4% and 57.6% R-squared is obtained for the models, when looking at scores or number of obtained Stars This slight change is probably due to the fact that adding variables, generally speaking, increases the R-squared (Brooks & Tsolacos, 2010).

Table 8

Regression results for Gross Rental Yield (GRY) for Comparison and Convenience buildings

	Model 4 (Comparison)		Model 4 (Convenience)	
Indep. var.	BREEAM Score	BREEAM Stars	BREEAM Score	BREEAM Stars
BREEAM score	0.013		-0.034***	
	(0.042)		(0.012)	
1 Star (Pass)		0.457		-0.103
		(0.415)		(0.203)
2 Stars: Good		-		-0.859***
				(0.269)
Ln(NLFA)	0.037	-0.006	0.183*	0.189*
	(0.147)	(0.145)	(0.235)	(0.099)
Ln(Age)	-1.051**	-1.035**	-0.282	-0.257
	(0.363)	(0.350)	(0.235)	(0.231)
OR	-0.009	-0.003	-0.011**	-0.009*
	(0.014)	(0.015)	(0.005)	(0.005)
WS	-0.396***	-0.491***	0.017*	0.015*
	(0.129)	(0.152)	(0.009)	(0.009)
VHU	6.938***	7.684***	-0.743	-0.573
	(1.763)	(1.820)	(0.679)	(0.682)
HU	6.487***	7.334***	-0.800	-0.751
	(1.674)	(1.797)	(0.795)	(0.634)
MoU	7.755***	8.177***	-1.273	-1.15
	(0.158)	(1.570)	(0.795)	(0.781)
MiU	-	-	0.165	0.288
			(0.861)	(0.849)
Ln(AI)	-2.254	-2.586	-3.100***	-2.358**
	(4.112)	(3.980)	(0.985)	(0.930)
AdH	-0.503	-0.854	0.894***	0.906***
	(0.688)	(0.730)	(0.245)	(0.236)
AdT	0.055	0.0249	0.049	0.038
	(0.064)	(0.066)	(0.030)	(0.028)
Constant	51.197**	61.228**	16.805***	13.243***
	(21.805)	(22.909)	(3.430)	(3.314)
Observations	27	27	62	62
R-squared	0.815	0.823	0.544	0.576
Adj. R-squared	0.679	0.701	0.431	0.458

Note: Dependent variable is GRY. Standard errors are in parentheses. NU (Not Urban) is omitted for being a reference dummy. For Comparison, BREEAM: Good and MiU (Mildly Urban) for having no data. *** p<0.01, **p<0.05, *p<0.1.

Since no statistically significant results for BREEAM score or Stars are found for Comparison for either BREEAM score of number of Stars, they both are analysed as one. For Comparison buildings the results state that when 1 Star is obtained compared to 0 Stars, a counterintuitive, positive coefficient is found, however this coefficient is not statistically significant. No further interpretation can be provided for the BREEAM score of Comparison. Controlling variables Walkscore and the Urban index are statistically significant at a 1% level and age is statistically significant at a 5% level. From an investor perspective, the locational variables state major negative effects on the GRY. The results suggest that the GRY will rise excessively if the retail building is located in denser populated areas. Reason for this result could lie in the distribution of BREEAM stars, being more present in 1 Star Comparison building, rather than in 0 Stars buildings, making the two relatively incomparable. For Convenience buildings, the results state a statistically significant result for BREEAM score, that a 1 basepoint increase in BREEAM score would result in a 0.034 basepoint decrease in GRY, ceteris paribus. This relation is most likely due to the heavy influence of having 2 Stars, rather than 1 Star. When 1 Star is obtained compared to 0 stars, an expected negative coefficient is found. However, the coefficient is not statistically significant. As seen before in Table 7, Table 8 states that Convenience buildings that have obtained 2 Stars show a statistically significant result at the 1% level. Table 8 presents that the GRY lowers with 0.859 base points when 2 Stars are obtained, when compared to having 0 stars, ceteris paribus. This means that a more sustainable, 2 Star rated, Convenience building obtains a large financial premium, as opposed to having 0 Stars. Similar conclusions are drawn by Fuerst & McAllister (2011) and Devine & Kok (2015), stating that more sustainable buildings gain financial premiums and lower perceived future risk. Although stating a premium, the result is to be interpreted with care since high costs for upgrading could be present but are not included in this result (Chegut et al. 2014). The results for Convenience suggest that the GRY is influenced by the distance towards highways as the relative wealth of the local inhabitants. An extra kilometer away from a highway entry would result in increasing GRY, while an increase in spending power of the inhabitants would decrease the GRY. Reason for this could be in the definition of Convenience buildings, namely being focused on supplying locally situated inhabitants who are doing groceries. If an increase in wealth would appear, more quality products could be bought, resulting in probably higher sales (Kumar & Karande, 2000).

7. DISCUSSION & CONCLUSION

This study researched the effects of the sustainability label BREEAM on the Gross Rental Yield (GRY) of retail real estate. Exploring this literature did provide insights for decision-making of investors regarding real estate. Additionally, the field of research on retail real estate is lacking substantiation on sustainability and its effects on the financial performance. Based on a literature review, a regression model was designed to test the effect of BREEAM, while controlling for building, location and municipal characteristics of retail buildings, thereby reducing the omitted variable bias.

A hedonic pricing method was designed, based on Rosen (1974), and applied, resulting in four models for OLS regression. The models differ from each other by representing buildings either BREEAM labelled or not, by using BREEAM as score (on a scale of 1 to 100) or, by stating BREEAM in terms of obtained Stars (classification for percentage ranges) and finally, providing insights in two types of retail real estate. The models were applied to an enriched dataset, consisting of 89 buildings dispersed over 40 locations. During this research, there was tension between the conceptual modelling and applied statistical methods and the eventually available data.

The outcome of the first model leaves the first hypothesis unconfirmed since no statistically significant result was found for having a BREEAM label on its own. This is in contrast to most of the previous research on sustainability labels. However, the results demonstrate that increasing the BREEAM score adds value to retail buildings, represented by a statistically significant decrease of 0.024 basepoints in GRY, confirming the second hypothesis. This could be due to tangible or intangible effects, resulting in a lower perceived risk for investors. The third hypothesis, regarding the effect of obtained Stars cannot be confirmed nor rejected, for lack of statistical significance among the different number of Stars, making comparison inconclusive. The results regarding the third hypothesis therefore show, to a certain extent, similar implications as in the research of McGrath (2013). The same applies for the fourth hypothesis when the data are ordered into different types of real estate. The results for Comparison buildings show lack of statistical significance for both BREEAM relative score and number of Stars. However, having 2 Stars does show a decrease in GRY for Convenience buildings by 0.859 basepoints, compared to having 0 Stars.

The results are based on the investor perspective and could therefore fuel discussions between tenants and investors (Eichholtz et al. 2015). Unlike EPC-labels for individual stores, BREEAM-scores are based on a building level. Although statements regarding BREEAM on a building level are still relevant for individual shops, tenants tend to focus on sustainability effects for their specific store at hand. As a result, to properly implement any changes to acquire a higher BREEAM-score, the tenant might not be convinced of the prospected gains over time (Chegut et al. 2014). This issue has been confirmed by various interviews with real estate professionals, who suggest an additional qualitative study on the effect of BREEAM on Dutch tenant-level performance could be valuable. Furthermore, analysing the financial implications for tenants might need the implementation of a different model. A hierarchical linear model is suggested to consider the higher BREEAM score on building level and the associated effects on multiple financial performance indicators of low-level tenants, in the same BREEAM-rated building (Venhorst, 2020).

The main shortcoming of this research has been a limited access to required data, being a challenge across earlier studies too. This limitation is considered to be the main reason for these results that are statistically insignificant. In addition, the available data are based on one point in time, the fourth quarter of 2019, and no data regarding investment costs. As described in Chapter 5, the conclusions regarding the effect of BREEAM could therefore be overestimated since the costs of upgrading property to improve BREEAM and the time effect of money are not explicitly included in the model. Nonetheless, the market value component of GRY implicitly considers these effects, to a certain extent. Nevertheless, the findings of this research are an addition to the current literature on the Dutch retail real estate market and the effects of BREEAM. The results can be used by real estate professionals to support their decision making with respect to sustainability measures, aiming to improve the financial and environmental performance of owned or prospective retail real estate.

This paper suggests that detailed studies regarding customer shopping behaviour and financial performance of increasingly sustainable retail real estate would be relevant. Additionally, it would be interesting to study which building improvements, following the aspects of BREEAM, would be most financially profitable. The eight aspects of BREEAM could be further explored to gain understanding what exactly drives vital changes in sustainability, resulting in the most efficient building improvements. Although touched upon initially during this study, this refinement had to be considered outside the scope of this research. Although retail real estate clearly faces challenges, the economic growth might provide drivers for future opportunities. An in-depth sensitivity analysis on the effects of sustainability in wealthier places could be tested, likely showing a stronger effect on GRY, and hence driving a more ‘made-to-measure’ development approach.

REFERENCES

Ahn, Y. H., Pearce, A. R., Wang, Y. & Wang, G. (2013). Drivers and barriers of sustainable design and construction: The perception of green building experience. *International Journal of Sustainable Building Technology and Urban Development*, 41(1), 35-45.

Arif, M., Egbu, C., Haleem, A., Kulonda, D., Khalfan, M. M. (2009). Green construction in India: Gaining a deeper understanding. *Journal of Architectural Engineering*, 15(1), 223-234.

Brooks, C. & Tsolacos, S. (2010*). Real Estate Modelling and Forecasting*. Cambridge: Cambridge University Press.

BREEAM. (2020a). *What is BREEAM?* Retrieved January 8th, 2020 from: https://www.breeam.com/.

Colliers International. (2019). *What's in a yield? Creating a Benchmark Comparison for European Markets.* [Online] Retrieved April 15th, from : https://www.colliers.com/-/media/files/emea /emea/research/investment/colliers_emea_whats-in-a-yield_2019.pdf?la=en-gb

Chegut, A., Eichholtz, P., Kok, N. (2014). Supply, Demand, and the Value of Green Buildings. *Urban Studies*, *55*(1), 22-43.

Chegut, A., Eichholtz, P., Kok, N. (2019). The price of innovation: An analysis of the marginal cost of green buildings. *Journal of Environmental Economics and Managements*, 98, 102248.

Darko, A., Zhang, C., Chan, A.P.C. (2017). Drivers for Green Building: A Review of Empirical Studies. *Habitat Int.*, 60, 34–49.

Devine, A., & Kok, N. (2015). Green Certification and Building Performance: Implications for Tangibles and Intangibles. *Journal of Portfolio Management,* 41(6), 151-163.

Dutch Green Building Council (DGBC). (2020). *BREEAM*-NL In-Use. [online] Retrieved February 15th, 2019, from: https://www.breeam.nl/keurmerken/in-use.

Eichholtz, P., Kok, N. & Quigly, J. M. (2010). Doing Well by Doing Good: Green Office Buildings. *American Economic Review*, 100, 2494-2511.

Eichholtz, P., Kok, N. & Quigley, J. M. (2013). The Economics of Green Building. *Review of Economics and Statistics*, 95(1). 50–63.

Eichholtz, P., Kok, N., & Quigley, J. M. (2015). Ecological Responsiveness and Corporate Real

Estate. *Business & Society*, 55(3), 330-360.

Energy Star. (2020) ENERGY STAR Overview. [online] Retrieved February 8th, 2020, from: https://www.energystar.gov/about.

Falkenbach, H., Lindholm, A. L., & Schleich, H. (2010). Environmental sustainability: Drivers for the real estate investor. *Journal of Real Estate Literature*, 18(2), 203-223.

Feige, A., McAllister, P. & Wallbaum, H. (2013). Rental price and sustainability ratings: which sustainability criteria are really paying back? *Construction Management and Economics*, 31(4), 322-334.

Fuerst, F. and McAllister, P. (2011) Green noise or green value? Measuring the effects of environmental certification on office values. *Real Estate Economics*, 39, 45–69.

Fuerst, F. and Weteringe, J. van de. (2015). How does environmental efficiency impact the rents of commercial offices in the UK. *Journal of Property Research*, 32(3), 193-216.

Holton, R. (1958). The Distinction between Convenience Goods, Shopping Goods, and Specialty Goods. *Journal of Marketing*, 23(1), 53-56.

ING REF & University of Maastricht. (2017). *"Groenwaarde" wetenschappelijk bewezen in Nederlandse kantorenmarkt*. Amsterdam: ING Bank N.V.

KPMG. (2020). *Global retail trends 2020*. [online] Retrieved July 15th , 2020, from: https://assets.kpmg/content/dam/kpmg/xx/pdf/2020/05/global-retail-trends-2020.pdf

Kok, N. & Jennen, M. (2012). The Impact of Energy Labels and Accessibility on Office Rents. *Energy Policy*, 46(3), 489-497.

Kumar, V., Karande, K. (2000). The effect of retail store environment on retailer performance. *Journal of business research*, 49(2), 167-181.

Lazrak, F., Nijkamp, P., Rietveld, P. and Rouwendal, J. (2014), "The market value of cultural heritage in urban areas: an application of spatial hedonic pricing". *Journal of Geographical Systems*, 16(1), 89–114.

Low, S. P., Gao, S., See, Y. L. (2014). Comparative study of project management and critical success factors of greening new and existing buildings in Singapore. *Structural Survey*, 32(5), 413-433.

Leskinen, N., Vimpari, J., Junilla, S. (2020) A Review on the Impact of Green Building Certification on the Cash Flows and Values of Commercial Properties. *Sustainability*, 12(15), 6203.

Lopez-De-Silanes, F.; McCahery, J.A., Pudschedl, P.C. (2020). ESG performance and disclosure: a cross-country analysis. Singapore Journal of Legal Studies. 217-241.

Nanthakumaran, N., Watkins, C., & Orr, A. (2000). Understanding property market dynamics: insights from modelling the supply-side adjustment mechanism. *Environment and Planning A*, 32(4), 655-671.

Miller, N., Spivey, J. and Florance, A. (2008) Does green pay off? *Journal of Real Estate Portfolio Management*, 14, 385–400.

Miller, J. & Garber, B.(2013). Green building and property value: a primer for buildings owners and developers. Washington: Institute for Market Transformation and Appraisal Institute

Organisation for Economic Cooperation and Development (OECD). (2013). *Handbook on Residential Property Prices Indices (RPPIs).* 1st Edition. Publications Office of the European Union. Belgium.

Pivo, G., & Fisher, J. D. (2011). The walkability premium in commercial real estate investments. *Real Estate Economics*, 39(2), 185-219.

Pulselli, R.M., Simoncini, E., Pulselli, F.M., Bastianoni, S. (2007). Energy analysis of building manufacturing, maintenance, and use: Em building indices to evaluate housing sustainability. *Energy and Buildings*, *39*, 620-628.

UNEP. (2009). *Buildings and Climate Change*. Paris: United Nations Environmental Programme.

UNEP Finance Initiative. (2015). Integrating Climate Risks in Real Estate. Retrieved January 8th, 2020, from: https://www.unepfi.org/fileadmin/documents/IntegratingClimateRisksInRealEstate.pdf.

Younger, M., Morrow-Almeida, S., Vindigini, S., Dannenberg, A. (2008). The built environment, climate change, and health. Opportunities for co-benefits. *American Journal of Preventive Medicine*, 35(5), 517-526.

Rijksdienst voor Ondernemend Nederland (RVO). (2020). Duurzaam gerenoveerd of zeer duurzaam nieuw utiliteitsgebouw volgens BREEAM-NL. Retrieved February 24th, 2020, from: https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/energie-besparen/europese-energie-efficiency-richtlijn-eed/energie-audit-eed/keurmerk.

Sayce, S., Ellison, L., Parnell, P. (2007). Understanding investment drivers for UK sustainable property. *Building Research & Information*, 35(5), 629-643.

Sopranzetti, B. J. (2010). Hedonic Regression Analysis in Real Estate Markets: A Primer. *Handbook of Quantitative Finance and Risk Management.* 1201-1207.

Syntrus Achmea. (2019). *Outlook Syntrus Achmea Real Estate & Finance, Strategy & Research*.

Tsolacos, S., Koegh, G., McGough, T. (1998). Modelling use, investment, and development in the British Office market. Environmental and Planning A. 30(8), 1409-1427.

Venhorst, V. (2020). Personal interview, Groningen. September 2, 2020.

Windapo, A. O., Goulding, J. S. (2015). Understanding the gap between green building practice and legislation requirements in South Africa. *Smart and Sustainable Built Environment*, 4(1), 67-

96.

Zuo, J., Zhao, Z. (2014). Green Buildings research-current status and future agenda: A review. *Renewable and Sustainable Energy Reviews*, 30, 271-281.

APPENDIX A: Procedure of BREEAM scoring

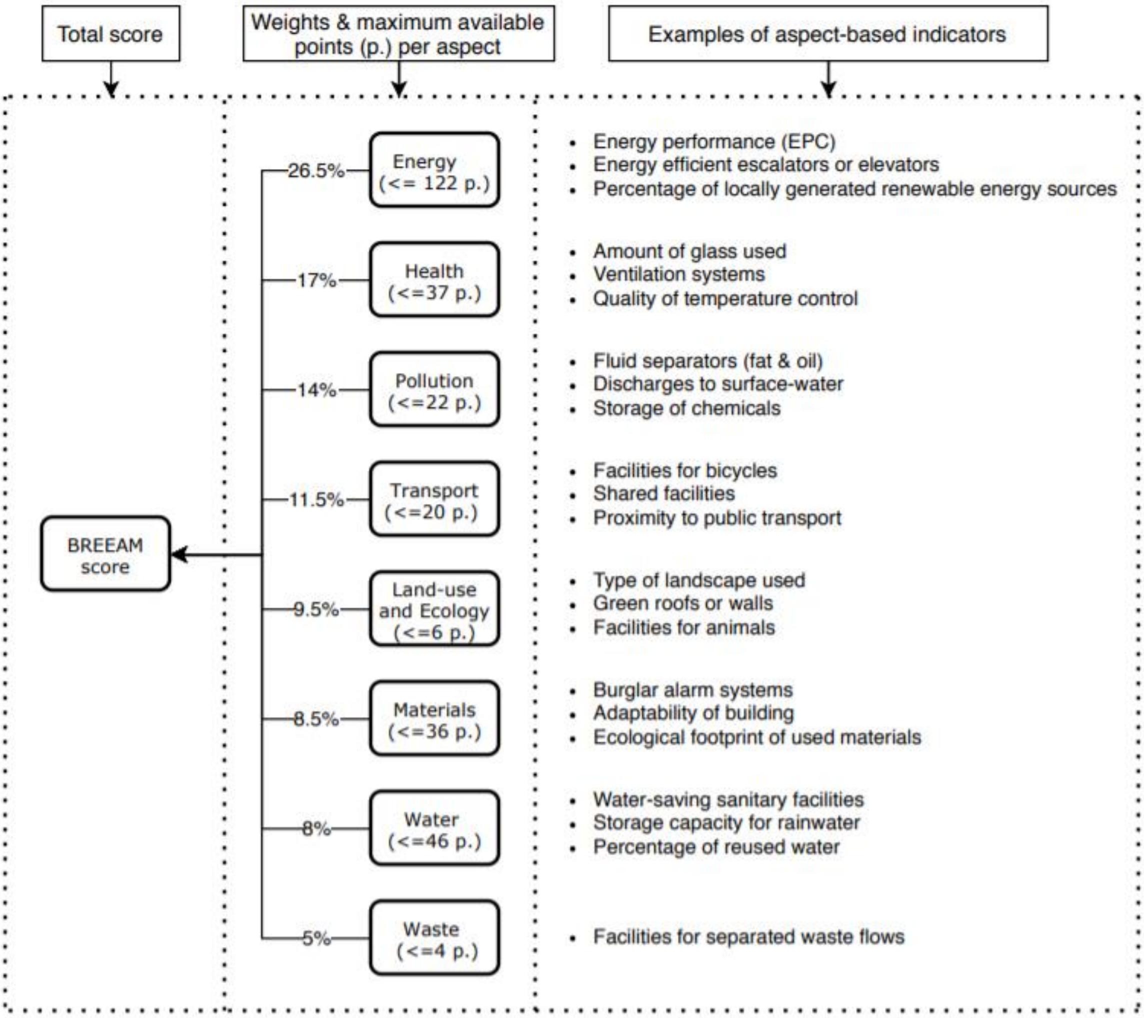


Figure 1: A simplified representation of the procedure resulting in a BREEAM score

APPENDIX B: Tables representing all stepwise additions to the statistical models

Table 5.1

Regression results for Gross Rental Yield (including P-values)

Indep. Var.	Coeffi.	P-value	Coeffi.	P-value	Coeffi.	P-value	Coeffi.	P-value
BREEAM-labelled	-0.068	0.759	-0.179	0.380	-0.270	0.197	-0.312	0.120
	(0.220)		(0.203)		(0.203)		(0.198)	
Ln(NFLA)			0.170	0.380	0.202**	0.032	0.213**	0.016
			(0.072)		(0.093)		(0.086)	
Ln(Age)			-0.359*	0.063	-0.557***	0.009	-0.622***	0.003
			(0.190)		(0.207)		(0.204)	
OR			-0.023***	0.000	-0.024***	0.000	-0.019***	0.001
			(0.006)		(0.006)		(0.009)	
WS					0.022**	0.027	0.017*	0.061
					(0.009)		(0.009)	
VHU					-0.384	0.561	-0.365	0.580
					(0.656)		(0.658)	
HU					-0.600	0.351	-0.334	0.601
					(0.6394)		(0.636)	
MoU					0.131	0.870	0.351	0.645
					(0.799)		(0.757)	
MiU					0.300	0.711	0.336	0.675
					(0.805)		(0.796)	
Ln(AI)							-1.984***	0.003
							(1.051)	
AdH							0.768**	0.046
							(0.249)	
AdT							0.051***	0.000
							(0.025)	
Constant	7.094***	0.000	9.320***	0.000	8.439***	0.000	13.574	0.000
	(0.176)		(1.177)		(1.450)		(3.725)	
Observations	89		89		89		89	
R-squared	0.001		0.238		0.316		0.4338	
adj. R-squared	-0.010		0.201		0.238		0.3444	

Note: Dependent variable is GRY. Standard errors are in parentheses. NU is omitted for being a reference dummy. *** p<0.01, **p<0.05, *p<0.1.

Table 6.1

Regression results for Gross Rental Yield (including P-values)

Indep. var.	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
BREEAM score	-0.102	0.435	-0.015	0.209	-0.018	0.143	-0.024**	0.049
	(0.013)		(0.012)		(0.012)		(0.012)	
Ln(NLFA)			0.178*	0.059	0.206**	0.029	0.223**	0.011
			(0.093)		(0.092)		(0.085)	
Ln(Age)			-0.373*	0.052	-0.562***	0.008	-0.610***	0.003
			(0.190)		(0.207)		(0.202)	
OR			-0.023	0.000	-0.023***	0.000	-0.019***	0.001
			(0.006)		(0.006)		(0.006)	
WS					0.020**	0.040	0.015*	0.095
					(0.01)		(0.009)	
VHU					-0.307*	0.640	-0.209	0.751
					(0.653)		(0.656)	
HU					-0.553	0.386	-0.210	0.743
					(0.634)		(0.632)	

MoU					0.152 (0.796)	0.849	0.400 (0.748)	0.595
MiU					0.400 (0.803)	0.620	0.445 (0.789)	0.574
Ln(AI)							-2.190** (1.055)	0.041
AdH							0.740*** (0.247)	0.004
AdT							0.058** (0.026)	0.026
Constant	7.355*** (0.402)	0.000	9.598*** (1.185)	0.000	8.850*** (1.462)	0.000	14.765*** (3.797)	0.000
Observations	89		89		89		89	
R-squared	0.007		0.245		0.320		0.441	
adj. R-squared	-0.004		0.209		0.242		0.353	

Note: Dependent variable is GRY. Standard errors are in parentheses. NU is omitted for being a reference dummy. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 7.1
Regression results for Gross Rental Yield based on BREEAM Stars (including P-values)

Indep. var.	Coefficient	P-value
1 Star (Pass)	-0.191	0.340
	(0.199)	
2 Stars (Good)	-0.833***	0.005
	(0.289)	
Ln(NLFA)	0.247***	0.005
	(0.085)	
Ln(Age)	-0.575***	0.005
	(0.120)	
OR	-0.017***	0.003
	(0.006)	
WS	0.014	0.124
	(0.009)	
VHU	-0.083	0.898
	(0.648)	
HU	-0.147	0.813
	(0.621)	
MoU	0.458	0.535
	(0.735)	
MiU	0.553	0.479
	(0.777)	
Ln(AI)	-1.956*	0.059
	(1.018)	
AdH	0.736***	0.003
	(0.241)	
AdT	0.054**	0.031
	(0.025)	
Constant	13.031***	0.001
	(3.619)	
Observations	89	
R-squared	0.4746	
adj. R-squared	0.3836	

Note: Dependent variable is GRY. Standard errors are in parentheses. NU is omitted for being a reference dummy.
*** p<0.01, **p<0.05, *p<0.1.

Table 8.1
Regression results for Gross Rental Yield for Comparison and Convenience buildings (including P-values)

	Comparison				Convenience			
Indep. var.	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
BREEAM score	0.013	0.762			-0.034***	0.007		
	(0.042)				(0.012)			
BREEAM: Pass			0.457	0.289			-0.103	0.615
			(0.415)				(0.203)	
BREEAM: Good			-				-0.859***	0.002
							(0.269)	
NLFA	0.037	0.803	-0.006	0.97	0.183*	0.075	0.189*	0.062
	(0.147)		(0.145)		(0.235)		(0.099)	

Ln(Age)	-1.051**	0.011	-1.035**	0.010	-0.282	0.235	-0.257	0.271
	(0.363)		(0.350)		(0.235)		(0.231)	
OR	-0.009	0.506	-0.003	0.849	-0.011**	0.040	-0.009*	0.072
	(0.014)		(0.015)		(0.005)		(0.005)	
WS	-0.396***	0.008	-0.491***	0.006	0.017*	0.090	0.015*	0.072
	(0.129)		(0.152)		(0.009)		(0.009)	
VHU	6.938***	0.001	7.684***	0.001	-0.743	0.280	-0.573	0.405
	(1.763)		(1.820)		(0.679)		(0.682)	
HU	6.487***	0.001	7.334***	0.001	-0.800	0.221	-0.751	0.242
	(1.674)		(1.797)		(0.795)		(0.634)	
MoU	7.755***	0.000	8.177***	0	-1.273	0.116	-1.15	0.145
	(0.158)		(1.570)		(0.795)		(0.781)	
MiU	-		-		0.165	0.849	0.288	0.735
					(0.861)		(0.849)	
Ln(AI)	-2.254	0.592	-2.586	0.526	-3.100***	0.003	-2.358**	0.015
	(4.112)		(3.980)		(0.985)		(0.930)	
AdH	-0.503	0.476	-0.854	0.26	0.894***	0.001	0.906***	0
	(0.688)		(0.730)		(0.245)		(0.236)	
AdT	0.055	0.402	0.0249	0.713	0.049	0.109	0.038	0.185
	(0.064)		(0.066)		(0.030)		(0.028)	
Constant	51.197**	0.033	61.228**	0.017	16.805***	0.000	13.243***	0.000
	(21.805)		(22.909)		(3.430)		(3.314)	
Observations	27		27		62		62	
R-squared	0.815		0.823		0.544		0.576	
Adj. R-squared	0.679		0.701		0.431		0.458	

Note: Dependent variable is GRY. Standard errors are in parentheses. NU (Not Urban) is omitted for being a reference dummy. For Comparison, BREEAM: Good and MiU (Mildly Urban) for having no data. *** p<0.01, **p<0.05, *p<0.1.

Table 9

Regression results for Gross Rental Yield for Comparison buildings (Including P-values)

Indep. var.	Coeffi.	P-value	Coeffi.	P-value	Coeffi.	P-value	Coeffi.	P-value
BREEAM score	0.093*	0.072	0.041	0.392	0.043	0.265	0.0128	0.762
	(0.049)		(0.046)		(0.037)		(0.042)	
NLFA			0.104	0.606	0.025	0.867	0.037	0.803
			(0.199)		(0.146)		(0.147)	
Ln(Age)			-0.633	0.106	-1.071***	0.003	-1.05**	0.011
			(0.375)		(0.317)		(0.363)	
OR			-0.028*	0.084	-0.004	0.751	-0.009	0.506
			(0.015)		(0.013)		(0.014)	
WS					-0.388***	0.001	-0.396***	0.008
					(0.101)		(0.129)	
VHU					5.689***	0.001	6.938***	0.001
					(1.494)		(1.763)	
HU					5.344***	0.001	6.487***	0.001
					(1.39)		(1.674)	
MoU					6.796***	0.000	1.58***	0.000
					(1.475)		(7.755)	
Ln(AI)							-2.254	0.592
							(4.110)	
AdH							-0.503	0.476
							(0.688)	

AdT							0.055 (0.064)	0.402
Constant	4.728*** (1.376)	0.002	10.23*** (3.227)	0.004	42.184*** (8.643)	0.000	51.197** (21.805)	0.033
Observations	27		27		27		27	
R-square	0.123		0.444		0.778		0.815	
adj. R-square	0.088		0.344		0.680		0.680	

Note: Dependent variable is GRY. Standard errors are in parentheses. MiU is omitted because of collinearity. NU is omitted for being a reference dummy. *** p<0.01, **p<0.05, *p<0.1.

Table 10

Regression results for Gross Rental Yield for Convenience buildings

Indep. var.	Coeffi.	P-value	Coeffi.	P-value	Coeffi.	P-value	Coeffi.	P-value
BREEAM score	-0.019 (0.012)	0.111	-0.0165 (0.011)	0.156	-0.028** (0.012)	0.023	-0.034*** (0.012)	0.007
NLFA			0.0827 (0.119)	0.488	0.1622 (0.119)	0.179	0.183* (0.100)	0.075
Ln(Age)			0.005 (0.263)	0.986	-0.111 (0.266)	0.678	-0.282 (0.234)	0.235
OR			-0.019*** (0.006)	0.004	-0.018*** (0.006)	0.004	-0.011** (0.005)	0.040
WS					0.021* (0.011)	0.058	0.017* (0.009)	0.090
VHU					-0.116 (0.792)	0.884	-0.743 (0.679)	0.280
HU					-0.704 (0.769)	0.364	-0.799 (0.644)	0.221
MoU					-0.878 (0.930)	0.350	-1.27 (0.795)	0.116
MiU					0.275 (0.878)	0.755	0.165 (0.861)	0.840
Ln(AI)							-3.100*** (0.984)	0.003
AdH							0.894*** (0.245)	0.001
AdT							0.049 (0.003)	0.109
Constant	7.543*** (0.376)	0.000	8.583*** (1.266)	0.000	7.486*** (1.612)	0.000	16.805*** (3.430)	0.000
Observations	61		61		61		61	
R-square	0.042		0.181		0.307		0.544	
adj. R-square	0.026		0.1226		0.1845		0.431	

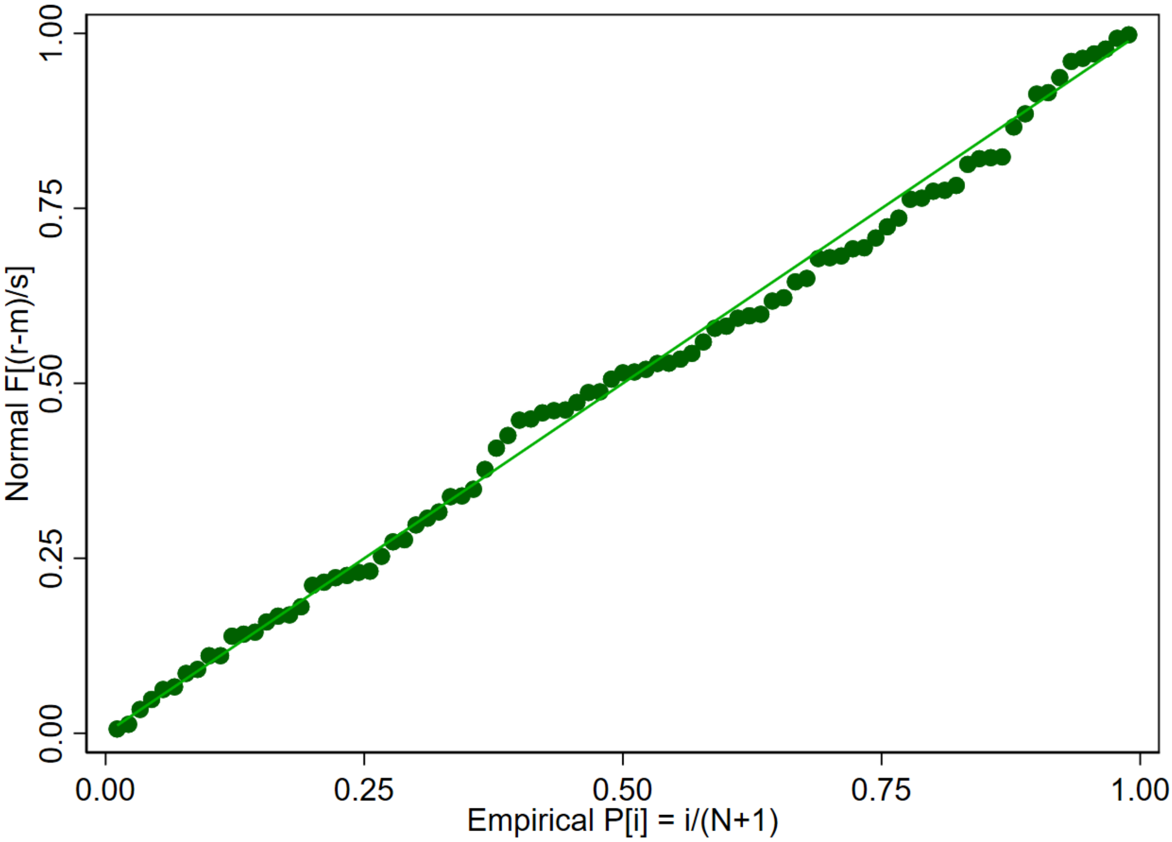
Note: Dependent variable is GRY. Standard errors are in parentheses. NU is omitted for being a reference dummy. *** p<0.01, **p<0.05, *p<0.1.

APPENDIX C: Assumptions testing

Ordinary Least Squares (OLS) assumptions are tested for the preferred model 2, where BREEAM is used as score.

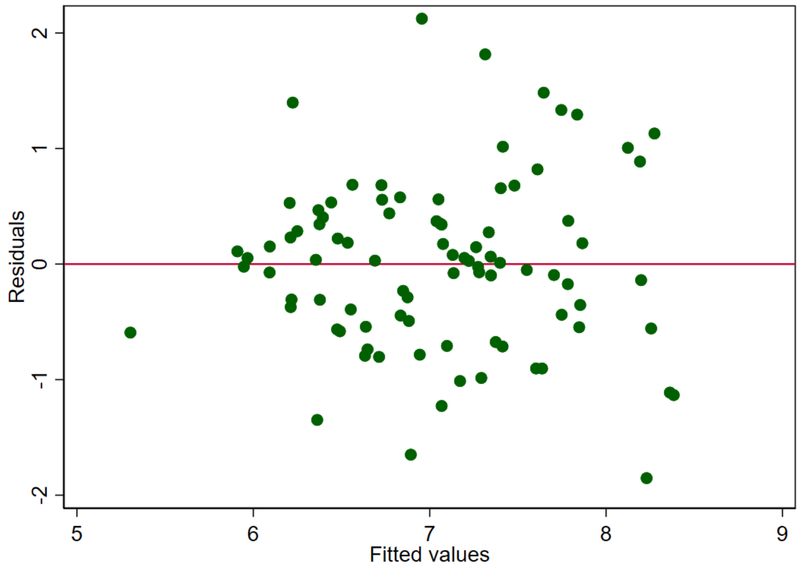
Assumption 1: the errors have a zero mean

This assumption is verified since the constant is added in the regression formula. Further, the error term approaches the average of 0 in the P-P plot.



Assumption 2: the variance of the errors is constant (homoscedasticity)

The assumption is visually verified by the 'rvfplot'. Afterwards the residuals are tested with the Breusch-Pagan / Cook-Weisberg test for heteroscedasticity. The Breusch-Pagan / Cook-Weisberg test has a null hypothesis stating homoscedasticity is present. Given the P-value of 0.1566, the null hypothesis cannot be rejected, therefore homoscedasticity is assumed.




```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: r

         chi2(1)      =     2.01
         Prob > chi2  =   0.1566
```

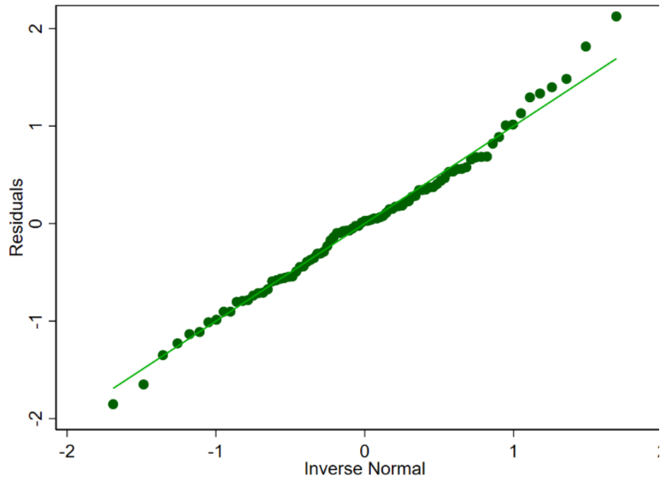
Assumption 3: the independent variables are statistically independent (no multicollinearity)

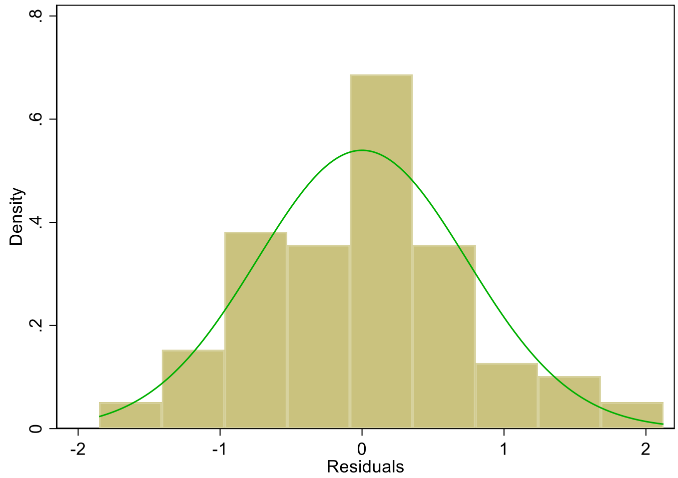
Testing the assumption for having no multicollinearity is done by using the Variance Inflation Factor (VIF). Lin (2008) and Brooks & Tsolacos (2010) state the VIF-values should be smaller than 10 to prevent multicollinearity. According to the table below, HU (Highly Urban) and VHU(Very Highly Urban) are presenting multicollinearity, stating a VIF of 11.28 and 12.73, respectively. This could result in biased regression coefficients for VHU and HU. However, these variables are used to control and not of direct interest, the analysis regarding to what extent BREEAM score influences the GRY is still meaningful.

Variable	VIF	1/VIF
HU	12.73	0.078535
VHU	11.28	0.088665
MoU	3.38	0.296019
MiU	2.85	0.350529
Distanceto~n	2.09	0.477693
lnincome	1.58	0.634771
lnAge	1.53	0.654257
Distanceto~y	1.44	0.696414
BREEAMScore	1.41	0.708278
Walkscore	1.24	0.807014
lnNLFA	1.21	0.824565
Occupancyr~e	1.14	0.878617
Mean VIF	3.49	

Assumption 4: the residuals are normally distributed

A Q-Q plot, histogram and Shapiro Wilk test are used to test the assumption of normally distributed residuals. The Q-Q plot shows slight deviations are shown in the 'tails', however the histogram follows the normality curve. The Shapiro-Wilk test is used to ensure that the residuals are normally distributed. The results show that the null hypothesis of normal data cannot be rejected. This means that the residuals are normally distributed making the results of the main model BLUE (Best Linear Unbiased Estimators).





Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
r	89	0.99187	0.609	-1.092	0.86269

Assumption 5: the covariance between residuals is zero (no autocorrelation)

The dataset in this research is not tested on autocorrelation since it does not use 'time series' or 'panel data'.

APPENDIX D: STATA Do-file

```
*import excel*

import excel "C:\Users\gebruiker\Desktop\Colliers Scriptie Rei\STATA\STATA databestand.xlsx", sheet("STATA ready") firstrow

rename VVOGOm NetLeasableFloorArea

rename MarktwaardekkQ42019 Marketvalue

rename Brutoopenmarkthuurwaarde Rent

rename Bouwjaar Constructiony

rename Leegstandpercentage Vacancyrate

rename ZeerSterkStedelijk VeryHighlyUrban

rename SterkStedelijk HighlyUrban

rename MatigStedelijk ModeratelyUrban

rename WeinigStedelijk MildlyUrban

rename NietStedelijk NotUrban

rename Gemiddeldgestandaardiseerdinkomen Averageincome

rename Afstandtotoprit Distancetowardshighwayentry

rename Afstandtottreinstation Distancetowardstrainstation

gen Age = 2019 – Constructiony

gen Stars0 = BREEAMScore  <= 24.99

gen Stars1 = BREEAMScore >= 25 & BREEAMScore <= 39.99

gen Stars2 = BREEAMScore >= 35 & BREEAMScore <= 54.99

gen Stars3 = BREEAMScore >= 55 & BREEAMScore <= 69.99

gen Stars4 = BREEAMScore >= 70 & BREEAMScore <= 84.99

gen Stars5 = BREEAMScore >= 85 & BREEAMScore <= 100

gen Occupancyrate = 100 - Vacancyrate

gen Averageincome1000 = Averageincome / 1000
```

```
gen VHU = VeryHighlyUrban > HighlyUrban & ModeratelyUrban & MildlyUrban & NotUrban

gen HU = HighlyUrban  > VeryHighlyUrban & ModeratelyUrban & MildlyUrban & NotUrban

gen MoU = ModeratelyUrban  > VeryHighlyUrban & HighlyUrban & MildlyUrban & NotUrban

gen MiU = MildlyUrban  > VeryHighlyUrban & HighlyUrban & ModeratelyUrban &  NotUrban

gen NU = NotUrban > VeryHighlyUrban & HighlyUrban & ModeratelyUrban & MildlyUrban

gen GRY = Marketvalue / Rent

drop if Stars4

drop if missing (Rent)

drop if Type = Specialty

sum

sum if Stars0

sum if Stars1

sum if Stars2

sum if Comparison

sum if Convenience

hist BREEAMScore  GRY  NetLeasableFloorArea  Constructiony Occupancyrate Averageincome1000
Distancetowardshighwayentry Distancetowardstrainstation, frequency normal bin(10)

swilk BREEAMScore GRY NetLeasableFloorArea  Constructiony Occupancyrate Averageincome1000
Distancetowardshighwayentry Distancetowardstrainstation

gen lnNLFA = ln(NetLeasableFloorArea)

gen lnAge = ln(Age)

gen lnIncome = ln(Averageincome1000)

gen Starsyes = Stars1 + Stars2

reg GRY Starsyes

reg GRY Starsyes lnNLFA lnAge Occupancyrate

reg GRY Starsyes lnNLFA lnAge Occupancyrate Walkscore  VHU  HU  MoU  MiU  NU
```

reg GRY Starsyes lnNLFA lnAge Occupancyrate Walkscore VHU HU MoU MiU NU lnIncome Distancetowardshighwayentry Distancetowardstrainstation

reg GRY BREEAMScore

reg GRY BREEAMScore lnNLFA lnAge Occupancyrate

reg GRY BREEAMScore lnNLFA lnAge Occupancyrate Walkscore VHU HU MoU MiU NU

reg GRY BREEAMScore lnNLFA lnAge Occupancyrate Walkscore VHU HU MoU MiU NU lnIncome Distancetowardshighwayentry Distancetowardstrainstation

reg GRY Stars0 Stars1 Stars2

reg GRY Stars0 Stars1 Stars2 lnNLFA lnAge Occupancyrate

reg GRY Stars0 Stars1 Stars2 lnNLFA lnAge Occupancyrate Walkscore VHU HU MoU MiU NU

reg GRY Stars0 Stars1 Stars2 lnNLFA lnAge Occupancyrate Walkscore VHU HU MoU MiU NU lnIncome Distancetowardshighwayentry Distancetowardstrainstation

reg GRY BREEAMScore if Comparison

reg GRY BREEAMScore lnNLFA lnAge Occupancyrate if Comparison

reg GRY BREEAMScore lnNLFA lnAge Occupancyrate Walkscore VHU HU MoU MiU NU if Comparison

reg GRY BREEAMScore lnNLFA lnAge Occupancyrate Walkscore VHU HU MoU MiU NU lnIncome Distancetowardshighwayentry Distancetowardstrainstation if Comparison

reg GRY BREEAMScore if Convenience

reg GRY BREEAMScore lnNLFA lnAge Occupancyrate if Convenience

reg GRY BREEAMScore lnNLFA lnAge Occupancyrate Walkscore VHU HU MoU MiU NU if Convenience

reg GRY BREEAMScore lnNLFA lnAge Occupancyrate Walkscore VHU HU MoU MiU NU lnIncome Distancetowardshighwayentry Distancetowardstrainstation if Convenience

reg GRY Stars0 Stars1 Stars2 if Comparison

reg GRY Stars0 Stars1 Stars2 lnNLFA lnAge Occupancyrate if Comparison

reg GRY Stars0 Stars1 Stars2 lnNLFA lnAge Occupancyrate Walkscore VHU HU MoU MiU NU if Comparison reg GRY Stars0 Stars1 Stars2 lnNLFA lnAge Occupancyrate Walkscore VHU HU MoU MiU NU lnIncome Distancetowardshighwayentry Distancetowardstrainstation if Comparison

reg GRY Stars0 Stars1 Stars2 if Convenience

reg GRY Stars0 Stars1 Stars2 lnNLFA lnAge Occupancyrate if Convenience

reg GRY Stars0 Stars1 Stars2 lnNLFA lnAge Occupancyrate Walkscore VHU HU MoU MiU NU if Convenience

reg GRY Stars0 Stars1 Stars2 lnNLFA lnAge Occupancyrate Walkscore VHU HU MoU MiU NU lnIncome Distancetowardshighwayentry Distancetowardstrainstation if Convenience

reg GRY BREEAMScore lnNLFA lnAge Occupancyrate Walkscore VHU HU MoU MiU NU lnIncome Distancetowardshighwayentry Distancetowardstrainstation

predict r

pnorm r

rvfplot, yline (0)

estat hettest r

vif

qnorm r

hist r, normal

swilk r