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Sustainability premium in the context of Dutch office real estate market, an interaction effect approach

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Abstract

New regulatory changes are forcing a change in the Dutch office real estate market. The biggest change will force all office properties to have an EPC label of C or better. However according to current estimations the expectation is that the transition of green offices will not be satisfied by 2023. As previous literature has shown the exact impact of these labels is not well understood by academia or investors. Hence, why there can be a lack of investing in the field of sustainable office real estate. This empirical research shows based on Dutch investor transaction office real estate data that there is a double digit premium for green properties, that train stations are not becoming more important in the scope of sustainability, but also that there is no time pressure premium due to the regulations.

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Contents

1. Introduction

The issue of sustainability has become of increasing importance in the fields of environment, business, politics, and society as a whole. Real estate is no exception to this new, salient topic. According to the European Commission, in 2019 buildings are responsible for approximately 40% of EU energy consumption and 36% of the greenhouse gas emissions. In 2015, with the signing of the Paris Agreement to make leaps towards a more sustainable environment, an important step has been made by making sustainability goals enforceable. The Netherlands is a player in the global market that is willing to make sustainability an widely accepted norm. For example, the Dutch government has made several steps through "Bouwbesluit 2012[1]", which requires all office properties to require a minimum Energy Performance Certificate[2] (EPC) of C in 2023. Currently, in the Netherlands, only 38% of office properties seem to satisfy this requirement (Rijksdienst van Ondernemend Nederland, 2021). This observed lacking pace can be explained through the fact that investments in sustainability can be very capital intensive. On top of that, investors in the industry do not always completely grasp the implications of the financial returns of sustainable investments, and literature shows varying premiums for green properties even when a plethora of research has shown that buildings that are more energy efficient do trade at a premium (Wiley et al., 2010; Eichholtz et al., 2010; Fuerst et al., 2011; Jennen and Kok., 2012).

As Corporate Social Responsibility and Sustainable Reporting takes on a leading role in the corporate world, real estate is no exception to this social pressure. However, if investors aim for these sustainable goals, it is required for them to understand if their investments generate value for their shareholders and stakeholders. Valuers are one of the most essential key players in this industry, as their valuations are usually leading for investors, bankers, and auditors. One of the reasons this cannot be done in practice is that measuring sustainability for valuation practices is still unreliable (Warren-Myers, 2012). As valuers cannot quantify the exact weight of sustainability, investors may be more reluctant in investing in sustainable investments if the financial incentives are not completely clear.

[1] Bouwbesluit 2012 contains regulations about safety, health, usability, energy efficiency, and environment for real estate in the Netherlands.

[2] Energy Performance Certificates (EPC) are schemes to rate the energy efficiency of buildings. All buildings are required to have an EPC rating in the Netherlands by law, par some exceptions.

Next to energy efficiency, another important part of sustainability is the location of the property and its relationship to transport. This is especially relevant due to the increasing transport costs and exorbitant housing prices. It has been noted that transport location impacts real estate properties in their valuation (Pivo and Fisher, 2011) and that other external factors can interact with location value (Fik et al., 2003). Therefore, this research will try to bring forth a model which not only looks at energy efficiency, but also at transport and the interaction between location and its surroundings. Sustainability is more than energy efficiency, and it is vital to also consider how well those properties can be reached in an environmentally friendly manner. Hence, the research question of this thesis will take a broader perspective with regards to sustainability.

To what extent does sustainability impact office valuation in the Dutch office real estate market?

Firstly, this thesis will scrutinize existing writings in commercial real estate about sustainability, energy efficiency, location, and transport, and their impact on real estate prices. Secondly, both the literature and the market situation will be used to derive few hypotheses to support the main research question. Thirdly, based on the existing papers and hypotheses, an ordinary least squares model, known as a hedonic pricing model, will be created to test the hypotheses. Then, the data and methodology will be discussed and the modifications that were required to make the data usable, then the paper will go over the results of the analysis. Lastly, the conclusion and discussion will comment on all findings, limitations, and future suggestions for this project.

2. Theoretical Framework

2.1 The need for sustainability

The real estate industry has received more attention with regards to their corporate social responsibility (CSR) better communication is expected towards the stakeholders. One of the topics that is essential in CSR in real estate is investments in new and existing real estate, especially sustainable real estate investments. Stakeholders want to know if firms are more actively contributing to a more sustainable environment. Luckily, organisations and firms have shown more commitment to their social responsibility. However, Warren-Myers (2012) and Dixon et al. (2008) mentioned that it is difficult to integrate the effects of sustainability into valuation methods and real world valuation models even when the environmental and social benefits are apparent for market participants. Sustainable real estate investments decrease the cost of energy, increase the quality of a property, and therefore increase in value as well (Jackson, 2009). Furthermore, sustainable properties also carry less risk, due to lower vacancy rates and fewer threats from future policies or governing bodies (Wiley et al., 2010). Despite all efforts, the exact financial returns are still not exactly understood.

2.2 Quantification of sustainability

Sustainability is hard to quantify in models because in itself it is an all-encompassing term for "the use of natural products and energy in a way that does not harm the environment and the ability to continue or be continued for a long time", according to the Oxford dictionary. So, it is nearly impossible to completely quantify sustainability as an independent agent. One of the most common approaches is using a form of energy and/or sustainability certification. The most commonly used ones are the Energy Star[3] and LEED[4] certifications for American research, and EPC labels for European research (Zancanella et al., 2018). Due to the nature of the criteria of the certifications, the results of various researchers show varying and volatile results in the expected premium for the certifications, and a stark difference between rental and sales transactions. One of the earliest paper that researched the topic of commercial real estate sustainability was Fuerst and McAllister (2008). They realised a premium of 31.4% for LEED certifications and 10.3% premium for Energy Star certifications for sales transactions, as well as 9.2% and 11.6% respectively for rental transactions. Additionally, higher ratings yield higher premiums, therefore implying that better ratings generate more value than ratings with lower yet satisfactory ratings. Another point that the authors noted is that the price premium might not be sustainable in the long run. Their 2008 findings might imply that there was a high demand effect that would decrease over time, aligning with the lower premiums in more recent research by Kok and Jennen (2012). Eichholtz et al. (2010) used the same labels and came to a conclusion that the actual effect of LEED and Energy Star are considerably lower: they found for sales transactions an increase of 11.1% for LEED and 13% for Energy Star, while on the other hand a significantly lower impact on rental prices. Rental prices received a mere premium of 5.8% for LEED certifications whilst Energy Star certifications had a premium of 2.1%. Additionally, smaller and more remote cities, as well as more peripheral parts of larger metropolitan areas see a higher impact on property values. This is the case due to the cost of land determining more of the price for central locations in metropolitan areas according to Eichholtz et al. (2010). Furthermore, a 10% decrease in

[3] Energy Star is a certificate which shows what energy standards a building satisfies.
[4] Leadership in Energy and Environmental Design (LEED) is a certificate that states how green buildings are, commonly used in the USA.

energy consumption leads on average to an increase of value by 1%. Therefore, a certification might not lead in itself to an increase in value. However, the signalling effects of certifications do seem to signal information about worker productivity or improved corporate image, which also adds value to green buildings in the market. When looking at research-based evidence on EPC labels in the United Kingdom there was no evidence to support that EPC labels impact rental or sales transaction prices (Fuerst & McAllister, 2011). However, the EPC ratings were close to being significant, but due to the poor sample size of the research as almost no property had an A EPC rating and a very small number had a B EPC rating therefore it had no statistical foundation to make inferences about green labels. It has to be noted that this research was done by taking all the possible commercial real estate, which also includes retail and industrial properties. As Fuerst and McAllister (2011) mentioned that the explanatory power seems higher for office properties compared to retail and industrial properties. On the other hand, Kok and Jennen (2012) did find a significant premium of 6.5% for rental transactions in the Netherlands. Additionally, green properties would improve the real estate portfolio of investors due to lower operational costs, improvement in marketability, and, so, they are better hedged against macroeconomic and market trends. Furthermore, it is important to highlight that in the Netherlands greener properties are located more often closer to train stations compared to properties that are not considered green. According to the authors greener properties allows for a more long-lived benefit from sustainability compared to properties that are not considered green. The implication of this is that it also creates more value for property owners through sustainability rather than just being more energy efficient. Based on the general overview from Zancanella et al. (2018), the consensus of researchers is that certifications and labels do put a premium on office real estate albeit with varying and volatile premia for different certifications, points in time, and types of transaction.

2.3 Policy change

The importance of sustainable real estate, which has been emphasized by academia over time, has also reached the political and legislative landscape. Bouwbesluit 2012 is the primary regulatory change in terms of sustainability for the Dutch office real estate market in recent years. The regulations are forcing the players in the Dutch office market to adopt a proper sustainable real estate investments mindset. The implications are that as of 1st January 2023 no office property cannot be used, leased, or sold with an EPC label worse than C. Additionally, the government is standardizing energy measurements through the NENnormen[5]. The aim is to reduce asymmetrical information, which allows investors, valuers, and other stakeholders to evaluate properties more fairly based on energy efficiency. However, there are some details and exceptions to the regulations of Bouwbesluit 2012. Only properties that are bigger than $100m^2$, with an office-focused function, and are not considered to be historic by Dutch heritage laws are obliged to comply with the regulations. The changes in regulations have created several consequences for participants in the market. Namely, real estate property owners have to make minor to major renovations to their properties if they want to maintain the usage of their property. Also, tenants have to look for new properties to house their operations if their current office does not satisfy the said requirement. As a consequence, there is a higher demand for office space that satisfies the EPC C requirement.

2.4 Current market circumstances

Naturally, the aforementioned paragraph creates a logical scenario for the upcoming future due to Bouwbesluit 2012. However, the supply side of the market behaves in a slightly different fashion from what one would expect. In the Netherlands, more than 50% of the office stock[6] is located in the G5[7] cities (Dynamis, 2020)[8], and with the lowest vacancy rate since 2002 around 8.2% (Cushman & Wakefield, 2021) [9], it veils to no surprise that good office space is considered a luxurious commodity, especially in G5 cities. In the Netherlands, according to the Economisch Instituut voor de bouw[10] (EIB) in 2020, at least 50% of the office properties have an EPC label of D or worse. Rijksdienst voor Ondernemend Nederland (RVO) current estimations as of January 2021 expect that with the current growth of transition most offices will not satisfy the EPC C requirement by 2023 unless drastic growth occurs in 2021 and 2022. This lack of growth of supply can be explained through the market research of the EIB in 2020. The investment costs per energy consumption savings disincentivises money lenders to invest in sustainable technologies for their existing properties. The annual costs and savings have negligible differences till EPC B. However, from an energy savings perspective, it becomes less valuable to go from a B to an A-label.

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[5] Nederlandse Norm (NEN) Is a partnership between the Dutch Standardisation institution (Stichting Koninklijk Nederlands Normalisatie Instituut) and the Dutch Electrical technology committee (Stichting Koninklijk Nederlands Elektrotechnisch Comité). The goal of the NEN is to created and stimulate measurement standardisations of products, processes, and services.
[6] Office stock is measured in surface area not in number of properties.
[7] Refers to Amsterdam, Den Haag, Rotterdam, Utrecht, and Eindhoven
[8] Dynamis is a Dutch real estate firm, which provide valuing services, research, asset management, acquisition, and other financial services.
[9] Cushman & Wakefield is a global commercial real estate firm
[10] A Dutch research organisation specialized in research for applied economic analysis in the field of construction and the built environment for market and government.

When looking at the ultimate goal of the Paris Agreement to become completely CO_2 neutral it seems more reasonable to not invest in sustainable technologies as annual costs are four times as much as the current annual savings. Another potential reason is that there are practical issues (Economisch Instituut voor de Bouw, 2021): property owners do want to invest in their existing non-green properties, but due to lease contracts with their lessees, it is in some cases impossible to renovate, as it can change rent prices or even halt operations. Furthermore, tenants have the option to hop more easily between properties as they are not bound by ownership of the latter. The potential future lack of satisfactory office space could lead to a green premium of properties that do satisfy the EPC C minimum requirement as supply is not growing as fast as the demand in the market.

2.5 Location in real estate

As G5 cities have historically low vacancy rates and extremely limited space it would be expected that smaller cities would transition faster to accommodate the energy transition for the office market. According to a report from Colliers (2021) the truth is actually the contrary. In the Netherlands, 3 out of the top 5 municipalities which have the most EPC C, or better properties, are located in the same municipalities where the G5 are located. Therefore, there is most likely another important driving factor that offsets the lacking pace of proper supply and the concentration of green offices in G5 cities. This factor is a very well researched aspect of any real estate model: land. Land can be split up in location and accessibility in the explanation of why offices are concentrated in certain locations, and why the transformation of real estate is mainly in these areas. Up to this day, the most important determining variable by which real estate prices are influenced is still the location of the property (Lorenz et al., 2006). The notion that land is the driving value can be seen not only in various pricing models in academia but also in professional valuations where location is one of the most important variables for valuation modelling according to the guidelines of the RICS[11]. The reason why G5 cities are the most occupied with office space but also the most expensive prices can be derived from the core characteristics of land and its accessibility. The market value of land is more expensive at better locations and cheaper at less advantageous sites (Pasquale & Wheaton, 1996). Therefore, cities with a monocentric city model, a city with one central point of employment, have higher real estate prices closer to the point of employment as opposed to real estate properties further from the centre (Alfonso, 2013;

[11] The Royal Institution of Chartered Surveyors (RICS) promotes and enforces the highest professional qualifications and standards in the development and management of land, real estate, construction and infrastructure

Mills, 1972; Muth, 1969). Alfonso and Muth's research stems as a basis to the bid-rent model, which proposes that participants in the real estate market push land prices up based of the territory's vicinity to the central business district (CBD). The relationship between distance and land prices can be derived from the principle of accessibility. The more convenient and cheaper it is to transport oneself to the CBD, the less utility the agent will lose in the market by living further from the CBD. Currently, the emphasis on land prices has decreased the demand pressure on centrally located properties due to lower accessibility costs (Fejarang, 1994). In fact, according to Fejarang, developments in infrastructure take away the demand pressure of centrally located properties by providing fast, convenient, and cheap solutions in terms of accessibility. People who locate themselves outside of the CBD but closer to good infrastructure enjoy the former's benefits, while not paying its exorbitant premium. Nonetheless, prices near transportation infrastructure also receive a premium for providing the service and ease of transportation. This observation that more people live further away from the CBD can also be seen in the Netherlands, where G5 cities have the 'best' transport infrastructure. A trend that has risen to prominence is the steady increase in congestion, transport costs, and housing costs, which has pushed employees further from the CBD and made employees look for more financial and sustainable solutions. In 2020 more people live further from work than they used to, for example, in the 90s, and more people than ever before commute for work to a different city (Planbureau voor de Leefomgeving, 2020). Furthermore, the total distance travelled by public transport has also increased steadily over the years, substantiating the fact that it is becoming more important as a method of transport for workers. The increase in usage of public transport can also be attributed to the need for a sustainable environment. Research on statistical trends done by the CBS (2018) found that 90% of the people feel the importance of a more sustainable environment; especially the younger generation deems sustainable energy as a necessity. Public transport therefore can provide part of the solution in terms of transportation.

2.6 The gradual increasing importance of accessibility

As more people are living farther away from their workplace, with increasing costs and more awareness in regards to sustainability, the form of transportation also becomes a more important decision. For long-range commutes there are two forms of transportation that stand out; car and train. It is, then, no surprise that in commercial real estate valuation literature highway and train station accessibility is considered an important contributing variable in the determination of the price of the property (Voith, 1993). Like train stations, the external benefits of highways are incorporated in the values of properties (Damm et al., 1980). Firms that are located closer to train stations and/or highways benefit from a premium, as it makes transportation much more convenient for employees. Kok and Jennen (2012) echo this notion in their research, which shows that offices located within 1 kilometre of the train station trade at a premium of 13% compared to properties that are farther away. Additionally, they note that more energy efficient properties are usually located near train stations, and, since location is fixed in time, they conclude that properties with suboptimal location benefit less from the trend in sustainability and lose value by having less access to public transport. However, they do not seem to find a significant effect for highway accessibility in their paper. Another paper done by Pivo and Fisher (2011) came to similar conclusions in terms of the importance of train stations. They observe a premium of 18% for properties within a half a mile radius (~0.8 km) of a train station, and therefore also conclude that more accessible properties have an advantage compared to properties that are not located favourably. So, properties that become more inconvenient to reach on foot will be less appealing. Overall, it seems that there is a general consensus in academia that train stations explain property values partially according to the meta-analysis of Debrezion et al. (2007). Moreover, it has to be noted that Fik et al. (2003) has mentioned that other external variables outside of the property can also interact with the property location itself as the idea of location is not properly understood. The paper states that location has interaction effects with other neighbouring properties from which the location actually derives its value. Therefore, this explains the value difference between the valued property and other factors that drive its value than just looking only at the location itself.

2.7 Hypotheses

As can be seen from Kok and Jennen (2012) their findings suggest that there is a significant green EPC premium for Dutch office rental transactions. On the other hand, Fuerst and McAllister (2011) have shown that there is no significant evidence of whether there is an

EPC premium on British commercial rental transactions. Besides it has to be noted from the research from Eichholtz et al. (2010) and others that there seems to be a stark difference between green premia depending on time, type of transaction, type of certification, and region. This sub-question will hence look at investment transactions and the green EPC premium of the transactions in the Dutch real estate market between 2015-2021. Therefore the first hypothesis will be:

H1: The green EPC premium in the Dutch office investment transaction market will show a significant positive green EPC premium.

As can be seen from Eichholtz et al. (2010) and looking at more recent literature price premia for green properties seem to drop. It was mentioned the fact that this was likely due to a short term demand pressure that would fizzle out over time as premia would be properly incorporated in the price, just as the efficient market hypothesis would state. The natural logic would be to expect that premia in this 2021 research would decrease to more negligible levels. But Bouwbesluit 2012 has naturally created a significant demand pressure due to the implementation of the regulations in 2023. The EIB estimated that in 2020 at least 50% of the office properties have an EPC rating of D or worse, and with the estimation of the RVO this gap will not be closed before 2023. Therefore the hypothesis will be:

H2: Recent transactions carry a more significant energy premium compared to transactions that were transacted earlier.

Furthermore, as Kok and Jennen (2012) have observed that greener properties are usually located near train stations compared to properties that are not green, which allows for sustainability benefits in the long run according to their research. Additionally, since people are more often travelling with public transport and from outside of the city, this will lead to the following hypothesis which tests for the potential interaction between greener locations and train stations as there is a shortage of green properties and better locations are more valuable.

H3: There is an interaction premium for green properties which are located near train stations.

Lastly, Eichholtz et al. (2010) findings state that the green energy premium is bigger in smaller cities and peripheral parts of metropolitan areas than metropolitan areas self. This was stated because land is a significantly more important part of the composition of property value for properties in metropolitan areas and it can be related back to the idea of the bid-rent model. The Netherlands on the other hand is different compared to American cities, which are in sizes relatively smaller. The G5 contains more than 50% of the office space and are at the same time the five biggest cities in the Netherlands, and are therefore considered as the biggest and most important office cities in the Netherlands. The last sub-question will therefore test if green premia are smaller in the G5 cities. The hypothesis of the last research question will be:

H4: The office properties in the G5 cities have a smaller green premium than office properties than cities outside of the G5.

3. Data & Methodology

3.1 Data

To research the impact of energy efficiency on the office real estate transaction prices, the internal database of Colliers will be used. This dataset contains information about all the Dutch office real estate investment transactions known by Colliers in the period 2015-2021. Furthermore, it contains data about the location, transaction date, square meters, postal codes vacancy rates, and addresses of the properties. The second database that will be used in the research is EP-online, which contains all the known data about energy labels in the Netherlands for all properties that have their energy efficiency registered. The third dataset that will be used will be retrieved from the Centraal Bureau voor de Statistiek, it contains information about highway access and train station vicinity in relationship to neighbourhoods in the Netherlands. Lastly, the BAG viewer[12] will be used to retrieve all the information regarding the construction year and addresses of the properties. The used investment data contains 1983 transactions in the Netherlands. For this research, the variables which lacked the information or unrealistic numbers were observed were removed from the sample size. To keep the data more consistent the following criteria were adopted in filtering bad data. First of all only office properties of or more than 100 m^2 were chosen for this research, since this number falls in alignment with the requirement of Bouwbesluit 2012. Secondly, only properties with an energy certification will be used in this research to make them applicable to this research. Thirdly, all properties with unavailable data in terms of address, postcode, city, square meters (SQM), and transaction price were excluded from the dataset.

3.2 Hedonic Pricing Model

To measure the impact of energy efficiency and location a widely adopted form of the ordinary least squares method is used, the Hedonic Pricing Model (HPM). One of the first papers that used the HPM was by Lorenz et al. (2007) to estimate the residential real estate values in relation to sustainability. Since then it has been widely adopted in commercial office real estate as well (Fuerst & Mcallister, 2008 & 2011; Pivo & Fisher, 2008; Eichholtz et al., 2010; Kok & Jennen, 2012; Dixon et al., 2014; Łaszkiewicz et al., 2019). In commercial real estate literature, hedonic pricing models are used to quantify the value of all

[12] Basisregistratie Adressen en Gebouwen viewer is a database where all addresses and properties are registered in the Netherlands, which is based on the cadastre.

contributing components of a pricing model, even of variables that do not have a market value attached to them.

Standard linear hedonic model: $V = \beta_0 + \sum_{k=1}^{K} \beta_k X_{k,i} + \varepsilon_i$

However, as all the aforementioned researchers in the Hedonic Pricing Model section use a log-linear model this research will transform all the transaction prices to natural logarithms[13].

Log-linear hedonic model: $\ln(V) = \beta_0 + \sum_{k=1}^{K} \beta_k X_{k,i} + \varepsilon_i$

Where ln(V) is the transaction price (value) of the office property. β_0 represents the constant, β_k represents each regressor of each independent variable of the model. The main variables of the model are continuous or dummy variables that represent the EPC labelling. The variables ($X_{k,i}$) that are used will be dummies or continuous variables associated with location, distance to highway and train station in kilometres, the surface area in square meters, the construction year, vacancy rate, and the transaction date of the properties. Lastly, ε_i represents the error term.

3.3 Interaction Effect

As Fik et al. (2003) mentioned, hedonic models do not incorporate location and the potential interactions between other independent variables, location will likely fall short to be able to explain the true impact of location on the market price of a property. To combat this it has been suggested to implement interaction terms to correct for it. Therefore in this research, an interaction effect will be applied to determine if location interacts with train stations as location value is determined by nearby properties and amenities and not its land value itself. The basic form of the interaction effect is based on the effect of Jaccard et al. (1996).

Interaction effect model: $Y = \alpha + \beta_1 X + \beta_2 Z + \beta_3 (X * Z)$

Where the β_1 and β_2 represent the regressors of the independent variables, α the constant, and Y the dependent variable. β_3 represents the regressor of the interaction between X and Z. Hence therefore the final model will take the form of:

$$\ln(V) = \beta_0 + \sum_{k=1}^{K} \beta_k X_{k,i} + \sum_{l=1}^{L} \beta_l \left(X_{k,i} * X_{k,i}\right) + \varepsilon_i$$

[13] Based on the normality test, which test for skewness and kurtosis it is apparent that Transaction Price is skewed to the right significantly. After transforming it to natural logarithm the normality test for skewness is still significant, however the dependent variable looks more normally distributed, making it for statistical inference more valid.

3.4 Descriptive Statistics

From table 1 it is clear that Transactionprice and Square Metres (SQM) have strong tails when it comes to their distributions based on their standard deviations. Looking at the accessibility variable distance to highway most of the properties are fairly closely located to a highway exit or access point by car. In regards to distance to train station most properties are closely located to a train station. It has to be noted that train stations in this paper are considered to be the important stations in the Dutch train infrastructure. The reasoning behind choosing only important train stations is because not every train station has the same value. Kok and Jennen (2012) have noticed this fact as well and therefore used an index to determine the importance of a train station as this information is not available a proxy is used. The CBS stats use the NS definition of important train stations and that is the one that will be used as a proxy for train station quality, as the most important train stations are the ones that employees use for their commute to their jobs if they live outside of the city. Looking at the distribution of EPCs 76.2% of the transacted office properties has an EPC label of C or better while only 23.8% have an EPC label of D or worse. In regards to the additional control dummy variables, location is defined as the G5 cities each with their own independent dummy, compared to the rest of the Netherlands. This approach was chosen to limit the number of dummies and also due to the fact that more than 50% of the offices are already in the G5 cities. The control variable transaction year is based on each year with 2020/2021 as the reference year. Construction year is divided into four categories, <1945, 1945-1999, 2000-2010, and with 2011-2021 as the reference group. Lastly, the vacancy rate is a continuous variable from 0% to 100%. An overview of all the variables and their statistical information can be found in the appendices.

Table 1 Descriptive statistics

Variables	N	Min	Mean	Max	St.Dev
Transaction price	1983	€ 78,500	€ 10,500,000	€ 352,000,000	€ 21,200,000
LN(Transaction price)	1983	11.27	15.22	19.68	1.36
SQM	1983	101	6022	75000	7134
LN(SQM)	1983	4.62	8.14	11.23	1.14
Distance to Highway	1983	0.60	1.93	3.00	0.45
Distance to Train station	1983	0.10	5.68	56.80	6.37
EPC					
Green	1512	76.2%			
Red	471	23.8%			
A or better	856				
B	263				
C	393				
D	161				
E	95				
F	76				
G	139				

4. Results

The results to see whether there is a significant premium on EPC certifications through the hedonic pricing method can be found in Table 2 and the results of the interaction effects in Tables 3 to 5. The dependent variable of the model is in all of the models the natural logarithm of the transaction price. It is to be noted that in all of the models heteroskedastic robust standard errors were applied, as all the models showed no significance of having homoskedastic errors according to the white test. In the first model, the regression shows that there is a significant price premium of 38.5% for office properties with an EPC A label compared to properties with an EPC D label, ceterius paribus. However, as can be seen from the table none of the other par EPC G has a significant effect. Even though when all variables independently do not all have significance according to the joint significance test between all the EPC labels, there is a joint significance in explaining transaction price. Furthermore, the order of premia hints at the fact that there is an omitted variable. As variables, G, F, and E carry a higher premium than properties with a D label. This is most likely due to the fact that most properties that have a worse label have other characteristics that give the property a price premium, such as build year and/or monumental status. Looking at model 2 the exact same regression was used, but instead of using all the EPC labels independently from each other model 2 compares the green labels (C or better) to the Red labels (D or worse). By doing this a premium of around 12.1% can be found for office properties with a green label. In model 3 a regression was used with continuous dummy variables of EPC labels, with G is

0, F is 1 and so forth till A which has a value of 6. This model shows a significant premium of 19.1%.

In models, 3 to 6 additional control variables are introduced to correct for the potential biases the previous three models can bring. In model 4 the same regression as in model 1 was used but with control and dummy variables for location, size, accessibility, construction year, transaction year, and vacancy rate. In model 4 the premium for EPC A has reduced to 27.5%, however as can be seen from EPC C, E, F, and G there is still an insignificant premium. As one of the control variables was construction year, which was significant for 2 out of the three dummy variables, it can be seen that the premium for the "historic" premiums for F and G labels has been reduced, but there is still an omitted variable based on the higher premia of E, F, and G. Even when the variables are not all significant, according to the joint significance F-test, EPC labels jointly do significantly estimate transaction price on a 1% significance level. In model 5 the same control variables were used as in model 4. As the table shows model 4 seems to have an EPC green premium of 15.2% compared to its previous model 2 of 12.1%. The model estimates that green premium is more important than in model 2 was estimated after controlling for omitted variables in model 2. In model 6 the continuous dummy EPC premium has decreased to 2.4% from 19.1% implying every improvement labelwise will net a premium of 2.4% for the property. This stark difference between model 3 and 6 can be attributed by looking at the distribution of the variable itself and its upward bias. An omitted variable bias such as build quality and historical value for the most extreme outliers is most likely the driving factor for the high premia. Build quality and historical value has a more severe impact on the continuous variable than the seperated variables in model 1 or in the grouped variable of model 2. As for the seperated variable or grouped variable models, the regression can differentiate better between the physicial characteristics. As for instance good quality properties are more common in A and better, and E, F, G properties tend to have more historical value. As this cannot be seperated in model 3 ,the coefficients between model 3 and 6 are shown to be more severe as model 6 is correcting this through other dummy variables, such as construction year, hence the drastic change. Looking at all the models (1 till 6) holistically model 4 seems to explain the variance the best based on the adjusted R-squared value. However, model 5 is a more parsimonious model with a similar adjusted R-squared based on the Bayesian Information Criteria (BIC) value.

Table 2 Regression results with dependent variable LN(Transaction price)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
EPC A	0.385***			0.287***		
	(0.066)			(0.055)		
EPC B	0.092			0.187***		
	(0.073)			(0.060)		
EPC C	0.079			0.066		
	(0.071)			(0.057)		
EPC E	0.145			0.0194		
	(0.109)			(0.078)		
EPC F	0.152			0.089		
	(0.115)			(0.082)		
EPC G	0.261**			0.107		
	(0.10)			(0.079)		
EPC GREEN		0.121***			0.152***	
		(0.045)			(0.037)	
EPC (CONTINUOUS)			0.191***			0.024***
			(0.016)			(0.006)
CONTROL VARIABLES						
SQUARE METRES	Yes	Yes	Yes	Yes	Yes	Yes
TRAIN STATION	No	No	No	Yes	Yes	Yes
HIGHWAY	No	No	No	Yes	Yes	Yes
VACANCY RATE	No	No	No	Yes	Yes	Yes
DUMMY VARIABLES						
LOCATION	No	No	No	Yes	Yes	Yes
TRANSACTION YEAR	No	No	No	Yes	Yes	Yes
CONSTRUCTION YEAR	No	No	No	Yes	Yes	Yes
CONSTANT	7.175***	7.262***	7.238***	8.241**	8.328***	8.488***
	(0.151)	(0.134)	(0.135)	(0.163)	(0.158)	(0.157)
R-SQUARED	0.678	0.668	0.670	0.799	0.796	0.795
BIC	4618.16	4672.16	4678.19	3850.49	3848.47	3872.38
JOINT F-TEST	12.69***	N.A.	N.A.	8.79***	N.A.	N.A.
NUMBER OF VARIABLES	7	2	2	23	18	18

Standard errors in parentheses
*** p<0.01, **p<0.05, *p<0.1

Looking at Table 3, which looks at whether the green premium impacts the G5 cities differently compared to the other cities outside of the G5 cities. Model 7 is the model with EPC Green as a dummy variable and model 8 uses the continuous dummy variable. Model 7 shows that green the EPC premium is statistically significant at a 1% significance level in the determination of the transaction price when correcting for interaction effects, however it does seem that the interaction effects give varying significance results, with Amsterdam and Utrecht being the only statistically significant interaction variables. A property in Amsterdam that is green will trade at a negative premium of 22.8%, which would imply that green premia in Amsterdam have a net negative effect in Amsterdam, which contradicts the premise that sustainable investments improve property value. This unexpected result can be explained through the fact that in Amsterdam 120 out of the 313 transactions were labelled with an E/F/G label. Coincidentally, the properties which belong to the aforementioned labels are mostly properties with historical and/or monumental value. Next to that these properties are also located mainly in the older neighbourhoods or city centre, which are more expensive than the average Amsterdam locations and therefore skew the coefficient downwards together with the monumental value. Eindhoven is considered to be statistically different from the other G5 cities in the Netherlands in this model, which implies that Eindhoven is more similar to non G5 cities than to the four biggest cities in the Netherlands when controlling for location green premium interaction effects. In model 8 the EPC continuous variable is shown to be statistically significant. It has to be noted that the only interaction effect that is statistically significant is Rotterdam. The EPC interaction premium is a positive 7% when the expected is to be expected to be negative as location value becomes gradually more of the dominating variable in pricing. As not all the interaction terms were statistically significant and both models gave various implications an F-test was used to determine if the variables are jointly significant in explaining transaction price. From that result, only model 7 can be concluded to be jointly significant at the 5% significance level.

Table 3 Regression results with dependent variable LN(Transaction price)

VARIABLES	**(7)**	**(8)**
EPCGREEN	0.182***	
	(0.043)	
EPC (CONTINUOUS)		0.022***
		(0.008)
AMSTERDAM	1.108***	0.939***
	(0.090)	(0.085)
ROTTERDAM	0.432***	0.269**
	(0.104)	(0.122)
DEN HAAG	0.652***	0.664***
	(0.104)	(0.105)
UTRECHT	0.850***	0.652***
	(0.134)	(0.148)
EINDHOVEN	0.086	0.091
	(0.223)	(0.172)
GREEN EPC/EPC (CONTINUOUS) * AMSTERDAM	-0.228**	-0.003
	(0.100)	(0.019)
GREEN EPC/EPC (CONTINUOUS) * ROTTERDAM	0.163	0.066**
	(0.131)	(0.026)
GREEN EPC/EPC (CONTINUOUS) * UTRECHT	-0.347**	-0.023
	(0.143)	(0.027)
GREEN EPC/EPC (CONTINUOUS) * DEN HAAG	-0.052	-0.017
	(0.118)	(0.023)
GREEN EPC/EPC (CONTINUOUS) * EINDHOVEN	0.130	0.029
	(0.234)	(0.037)
CONTROL VARIABLES		
SQUARE METRES	Yes	Yes
DISTANCE TO HIGHWAY	Yes	Yes
DISTANCE TO TRAIN STATION	Yes	Yes
VACANCY RATE	Yes	Yes
DUMMY VARIABLES		
TRANSACTION YEAR	Yes	Yes
CONSTRUCTION YEAR	Yes	Yes
CONSTANT	8.316***	8.378***

	(0.160)	(0.157)
R SQUARED	0.797	0.796
BIC	3874.51	3982.12
JOINT F-TEST	2.70**	1.85
NUMBER OF VARIABLES	23	23

Standard errors in parentheses
*** p<0.01, **p<0.05, *p<0.1

In Table 4 the results of the regression can be found for the green energy premium over time. The first striking matter of the two models is that the green labels nor the EPC continuous dummy variable are statistically significant. On the other hand, the transaction year is shown to be statistically significant at a 1% significance level. This is frankly expected as real estate prices tend to grow steadily over the years, which is also substantiated by the NVM's office real estate price index of 2015 up till 2020. In model 11 a continuous dummy variable is used to determine whether a parsimonious model might predict transaction price better. As can be seen from the model, transaction year as a continuous variable is significant at a 1% significance level. Based on the BIC value the parsimonious model does seem to predict transaction price better. Looking at all interaction effects of the three models none of the interaction terms is shown to be statistically significant, with some interaction effects showing a negative premium for green labels over time. Additionally, based on the results of the F-test it seems that better labels do not trade at an additional premium over time, as the F-test cannot provide any evidence for joint significance over the years.

Table 4 Regression results with dependent variable LN(Transaction price)

VARIABLES	(9)	(10)	(11)
EPCGREEN	0.106		
	(0.086)		
EPC (CONTINUOUS)		0.020	0.019
		(0.015)	(0.013)
2015	-0.553***	-0.444***	
	(0.112)	(0.111)	
2016	-0.453***	-0.447***	
	(0.100)	(0.095)	
2017	-0.350***	-0.381***	
	(0.096)	(0.081)	
2018	-0.280***	-0.257***	
	(0.101)	(0.087)	
2019	-0.273**	-0.206**	
	(0.108)	(0.098)	
TRANSACTION YEAR (CONTINUOUS)			0.090***
			(0.018)
EPCGREEN/EPC (CONTINUOUS) * 2015	0.139	-0.006	
	(0.140)	(0.027)	
EPCGREEN/EPC (CONTINUOUS) * 2016	-0.000	0.002	
	(0.113)	(0.021)	
EPCGREEN/EPC (CONTINUOUS) * 2017	-0.005	0.010	
	(0.108)	(0.019)	
EPCGREEN/EPC (CONTINUOUS) * 2018	0.066	0.007	
	(0.113)	(0.020)	
EPCGREEN/EPC (CONTINUOUS) * 2019	0.123	0.005	

	(0.121)	(0.022)	
TRANSACTION YEAR (CONTINUOUS) * EPC (CONTINUOUS)			0.002 (0.004)
CONTROL VARIABLES			
SQUARE METERS	Yes	Yes	Yes
DISTANCE TO HIGHWAY	Yes	Yes	Yes
DISTANCE TO TRAIN STATION	Yes	Yes	Yes
DUMMY VARIABLES			
CONSTRUCTION YEAR	Yes	Yes	Yes
LOCATION	Yes	Yes	Yes
CONSTANT	8.361*** (0.174)	8.362*** (0.168)	7.836*** (0.160)
R SQUARED	0.796	0.795	0.795
BIC	3883.53	3890.32	3835.13
JOINT F-TEST	0.55	0.15	
NUMBER OF VARIABLES	23	23	15

Standard errors in parentheses
*** p<0.01, **p<0.05, *p<0.1

In Table 5 the final two models will be used to determine whether being more closely located to a train station and being a green property reflects in the transaction price of a property. First as can be seen from models 12 and 13 the energy label premium is statistically significant at a 1% significance level. The distance to the train station is for both models identical and significant at a 1% significance level. Every kilometre decreases the property in value by 1.5%. Looking at the interaction terms of both models the coefficients show a change of almost 0.000, which implies that the interaction effect does not impact transaction price at all. Hence therefore, the interaction effects are both not significant.

Table 5 Regression results with dependent variable LN(Transaction price)

VARIABLES	**(12)**	**(13)**
EPCGREEN	0.147*** (0.047)	
EPC (CONTINUOUS)		0.021** (0.009)
DISTANCE TO TRAIN STATION	-0.015*** (0.004)	-0.015*** (0.003)
EPC GREEN * DISTANCE STATION	0.001 (0.005)	
EPC (CONTINUOUS) * DISTANCE STATION		0.000 (0.001)
CONTROL VARIABLES		
SQUARE METERS	Yes	Yes
DISTANCE TO HIGHWAY	Yes	Yes
DISTANCE TO TRAIN STATION	Yes	Yes
DUMMY VARIABLES		
CONSTRUCTION YEAR	Yes	Yes
TRANSACTION YEAR	Yes	Yes
LOCATION	Yes	Yes

CONSTANT	8.330***	8.352***
	(0.159)	(0.158)
R SQUARED	0.796	0.795
BIC	3856.03	3860.58
NUMBER OF VARIABLES	19	19

Standard errors in parentheses
*** p<0.01, **p<0.05, *p<0.1

5. Discussion

5.1 Hypotheses

This paper tried to dive deeper into the topic of sustainability self and how it influences property prices in the market through a hedonic pricing model. As sustainability is not merely the means of energy efficiency of properties, but also how employees, in this case, are located and by what means they travel. People in the Netherlands after all live further from their work than they used to be and the emphasis and awareness of sustainability of companies and people is increasing. The research question of this paper is: *To what extent does sustainability impact office valuation in the Dutch office real estate market?* To answer this broad question four hypotheses were created to tackle four questions regarding sustainability and office prices. These hypotheses will be reviewed in order to give a conclusion on the main research question.

H1: The green EPC premium in the Dutch office investment transaction market will show a significant positive green EPC premium. The results of this hypothesis do confirm the findings of Kok and Jennen (2012), which state significant green premia for rental transactions for office transactions in the Netherlands. It has to be noted that the green premium of this paper is 15.2% (model 5) compared to their paper which showed a green premium of 6.5%. This finding however that rental properties have a lower green premium compared to sales transactions is also found in research from Eichholtz et al. (2010). This can be potentially explained through property rights which happen with investment and sales transactions compared to rental transactions. Furthermore, it has to be noted just as in Kok and Jennen (2012), and Fuerst and McAllister (2011) cases there is no statistical evidence that better EPC labels independently charge higher premia. All in all, hypothesis 1 cannot be rejected as green labels do trade at a significant premium compared to red labels.

H2: Recent transactions carry a more significant energy premium compared to transactions that were transacted earlier. The findings for this hypothesis is that there is no statistical evidence that greener labels create a bigger green premium over the years. Even with the external supply shock of Bouwbesluit 2012, there seems no significant increase of premia.

Which could imply that investors in the office market do not worry about the upcoming regulatory changes. The findings of Eichholtz et al. (2008) stated that the exorbitant premia fizzles out over the years, which potentially can explain the case in this paper as there is no joint significance for green premia over the years. Another potential economic answer would be the efficient market hypothesis that markets correct for new information eventually. Therefore, the second hypothesis has to be rejected.

H3: There is an interaction premium for green properties which are located near train stations. The findings from this hypothesis can be shortly described as statistically non-significant, as none of the models show statistical significance. Therefore this hypothesis has to be rejected. There is no evidence that greener properties which are closer to train stations trade at a significant additional premium. Implying that greener properties near train stations do not charge an additional premium. One of the potential reasons why this might be the case is due to the lack of precision of the distance of the train stations. Train station distance is dependent on neighbourhood and not on actual distance based on their location, therefore reducing the accuracy and making it impossible to compare train station differences between properties in the same neighbourhood and their impact. The observation that Kok and Jennen (2012) made cannot be used to infer that the concentration of green properties near train stations are seen as more valuable by investors.

H4: The office properties in the G5 cities have a smaller green premium than office properties than cities outside of the G5. The findings from the results imply that the two models (Table 3) give different results in terms of significance. Model 7 implies for instance that Amsterdam has a negative interaction premium for green properties of 22.8%. This would not make logical sense as the green premium on its own is 18.2%, therefore implying a negative net premium for green properties in Amsterdam. Even when the estimators seem flawed, based on the joint F-test, the interaction effects of greener labels and location are statistically significant for the G5 cities. Implying and confirming what Eichholtz et al. (2010) have found that the green premium effect is more pronounced on the edges of metropolitan cities and more remote parts of the country. However, as the variables on their own are severely biased due to the historical value and specific locations of the properties, the hypothesis has to be rejected. It is not possible based on this research to conclude that the green premium in G5 cities is smaller than the rest of the country.

5.2 Limitations and suggestions

Having discussed the hypotheses, this part of the paper will go over the limitations of the research and give several suggestions before answering the research question in the conclusion. Firstly as mentioned in one of the hypotheses the proxy of distance to train station is a limiting factor that can be solved with more accurate data, which would give a more consistent and accurate estimator. Secondly, it has to be noted the distance to train station impacts differently across stations themselves. One train station could have inherently more value than other train stations. This has been partially circumvented in this research by using only important train stations. Future research could try to increase the accuracy by creating an ordinal scoring system, which Kok and Jennen (2012) have used and shown significant results. Another strong assumption that was made is that all variables are taken as linear over their values, which is a false assumption to make as for instance train stations have decreasing marginal utility for properties as the distance becomes larger (Debrezion et al., 2007). One way to solve this problem is by using an Artificial Neural Network Model, a method from machine learning that allows non-linear relationships and is stated by Peterson and Flanagan (2009) to outperform standard OLS methods. An additional strong limitation to this model is that a hedonic pricing model based on OLS assumes that transactions do not have spatial effects; spatial dependence and spatial heterogeneity (Wilhelmsson, 2002). Spatial dependence refers to the dependence of observations of nearby transactions and that it influences the outcome of the observed. Spatial heterogeneity refers to the variation of space in relation to the dependent variable. To correct for the spatial effects it is suggested to adopt a spatial econometric model that enables geographic relationships between the variables through the use of vectors and/or matrices. A spatial model would give a more efficient result, but it would not mean that the model in itself is biased (Dubin et al., 1999). Therefore making the standard HPM still valid with less complexity as spatial models also raise other issues.

Naturally, additional variables could be implemented in the model to make the model more accurate. The biggest variables that could add a significant contribution to the model are physical characteristics. Commercial real estate tends compared to residential real estate to have a lack of information in regards to the physical attributes of the property. And as offices are considered heterogeneous goods one office at the same location could have completely different physical characteristics that would charge a hefty premium on it. Additionally as found in the report of the EIB (2020) there is a strong difference between the return on investments when properties require investments to jump from B to A or better. This can be linked back to the more standard valuation method of office valuation such as the Discount Cash Flow method. A steeper investment should be offset by a bigger valuation increase compared to smaller investments, ceterius paribus. This could therefore hence explain why A+ or better properties show exorbitant price jumps in terms of valuation according to the model.

Lastly, this model has not included several external factors that might impact the usability of the model of this paper. Firstly, the appearance of COVID-19 has shaken the office real estate markets up. As transaction volume has dropped due to shutdowns of offices and workers are working from home. Consequently, COVID-19 also has sped up the process of the normalisation to work from home, which naturally would imply lower demand for office space. This however will be also counterbalanced by the concept of new workspaces, where offices focus more on meetings and gatherings, and less on actual desk spaces. Thirdly, the concept of flex offices is also gaining traction in the Netherlands, which gives tenants more flexible options for their needs, and allows property owners to attract different kinds of tenants next to their usual market. At last, this paper has not considered the impact of tax incentives. The Dutch Government has for instance incentivised sustainable investments by giving investors tax benefits on their taxable income and introduced new ones over the years. The effects of the aforementioned factors are excluded as they are beyond the scope of this research due to the complexity of the field such as taxes and subsidies, lack of data for flex offices, and the uncertainty of how the demand for office supply will change in the future.

6. Conclusion

With all the hypotheses answered, limitations discussed, and future recommendations the following concluding words can be said about the research question: *To what extent does sustainability impact office valuation in the Dutch office real estate market?* Energy efficiency and accessibility are crucial variables in determining the pricing of models. The variables of the research show significance on their own, however compared to what this paper has theorised there does not seem any evidence based on data and trends in society that energy premium is becoming more important over time, and that energy efficiency and accessibility show to have an additional premium together. These findings should give valuers more insight into the importance of energy premia as it can increase the valuation of a property significantly. Furthermore, the models in this paper allow for quick scans of properties and their valuations which could give initial insights to valuers of what the valuation could be according to data. For investors, the findings from this paper could give a more clear insight into how investments in energy efficiency properties and renovations can benefit their returns. From a policy point of view, these insights give a more solid understanding of how EPC labels impact office property valuations in the Dutch office markets based on investment data as there was no real evidence for the Dutch market for investment transactions. From a research point of view the insights of this paper confirm what past literature already has confirmed, but also new findings such as that time pressure does not necessarily imply a price premium, and that sustainable property premia are not necessarily more expensive in smaller cities compared to bigger cities.

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8. Appendix

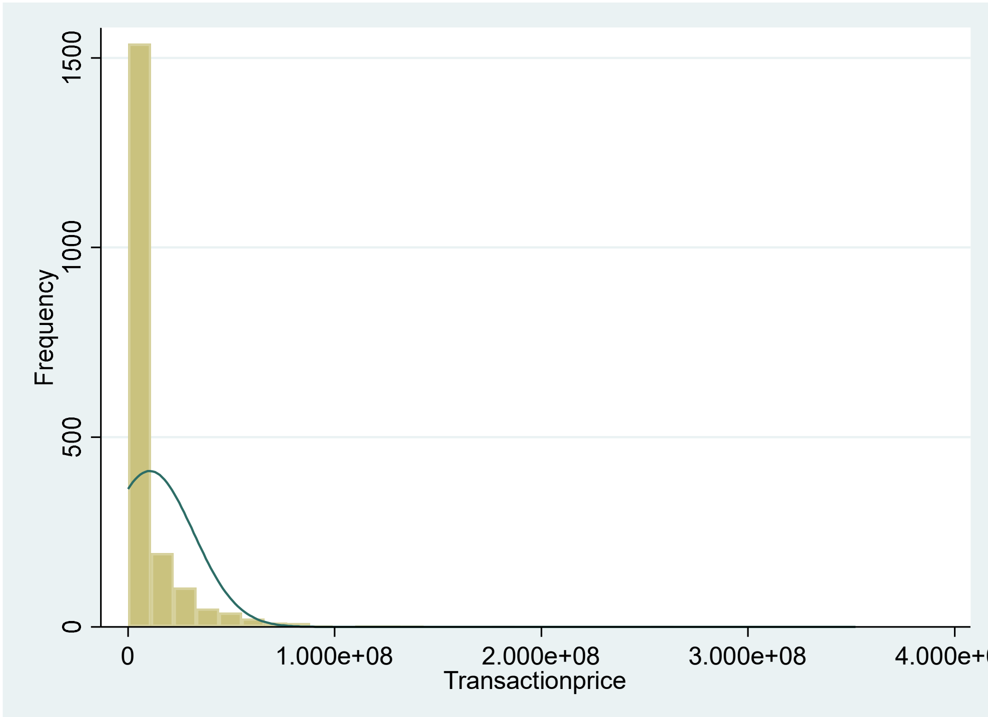

Figure 1: Distribution of Transaction price

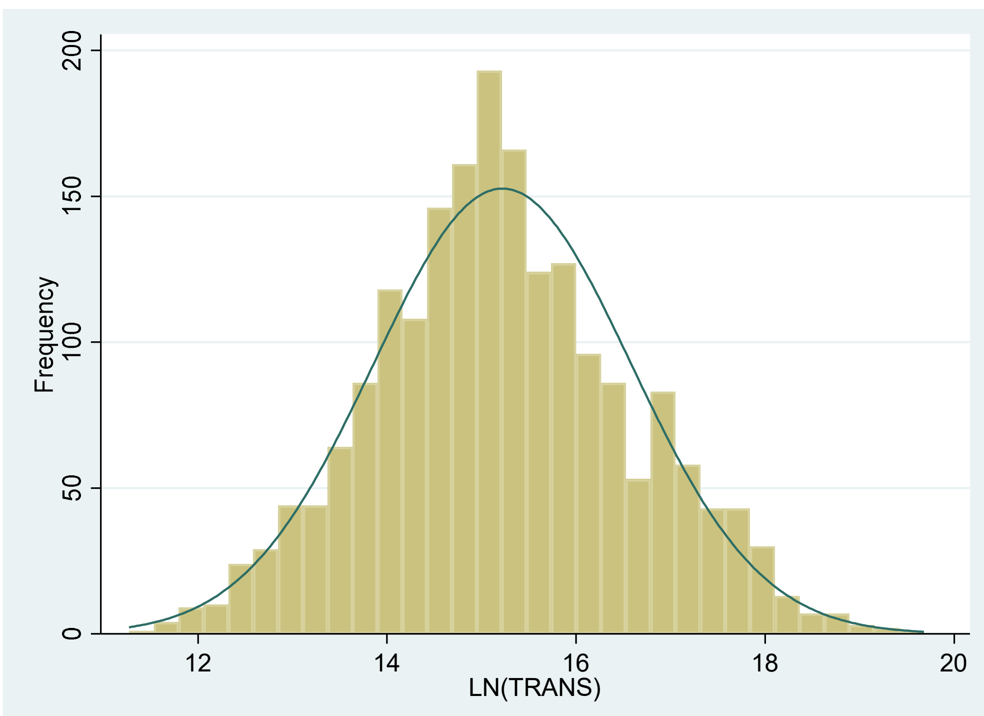

Figure 2: Distribution of Transaction price after natural logarithm transformation

Skewness and kurtosis tests for normality

Variable	Obs	Pr(skewness)	Pr(kurtosis)	Joint test Adj chi2(2)	Joint test Prob>chi2
LNTRANS	1,983	0.0066	0.2086	8.90	0.0117
Transactionprice	1,983	0.0000	0.0000	.	.

Table 4: Normality test of LN of transaction price and Transaction price

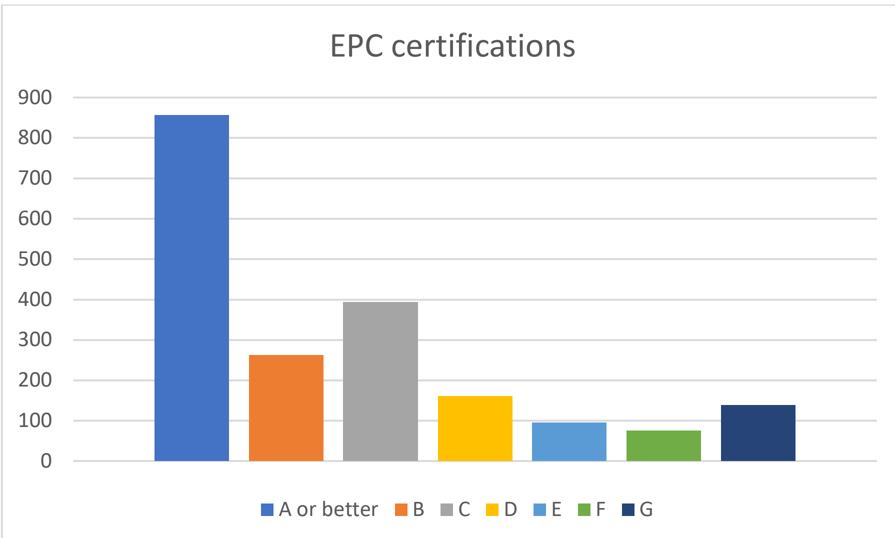

Figure 3: shows the distribution of the EPC labels of the transacted properties

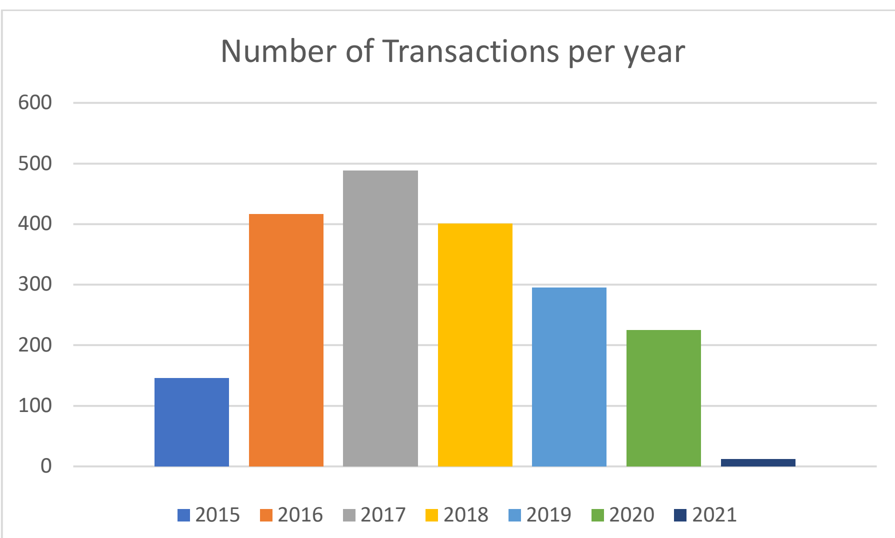

Figure 4: shows the distribution of the transactions per year.

	LNTRANS	LNSQM	EPCGREEN	EPCINDEX	EPCA	EPCB	EPCC	EPCD	EPCE	EPCF	EPCG	DTH	DTIS
LNTRANS	1.0000												
LNSQM	0.8164	1.0000											
EPCGREEN	0.1904	0.1886	1.0000										
EPCINDEX	0.2597	0.2514	0.8552	1.0000									
EPCA	0.2521	0.1860	0.4864	0.7430	1.0000								
EPCB	-0.0424	-0.0053	0.2182	0.1219	-0.3408	1.0000							
EPCC	-0.0739	-0.0254	0.2775	-0.1139	-0.4333	-0.1944	1.0000						
EPCD	-0.0377	0.0143	-0.5326	-0.2289	-0.2591	-0.1162	-0.1478	1.0000					
EPCE	-0.0809	-0.0841	-0.4019	-0.2940	-0.1955	-0.0877	-0.1115	-0.0667	1.0000				
EPCF	-0.0711	-0.0750	-0.3577	-0.3696	-0.1740	-0.0781	-0.0992	-0.0593	-0.0448	1.0000			
EPCG	-0.1559	-0.2029	-0.4919	-0.6568	-0.2393	-0.1074	-0.1365	-0.0816	-0.0616	-0.0548	1.0000		
DTH	0.1019	0.0240	-0.0033	0.0211	0.0381	-0.0216	-0.0325	0.0014	0.0188	0.0259	-0.0312	1.0000	
DTIS	-0.2286	-0.1343	0.0160	-0.0136	-0.0804	0.0780	0.0506	-0.0045	0.0135	-0.0064	-0.0283	-0.1664	1.0000

Table 6: correlation between LNTRANS (LN of Transaction price) between the other independent variables

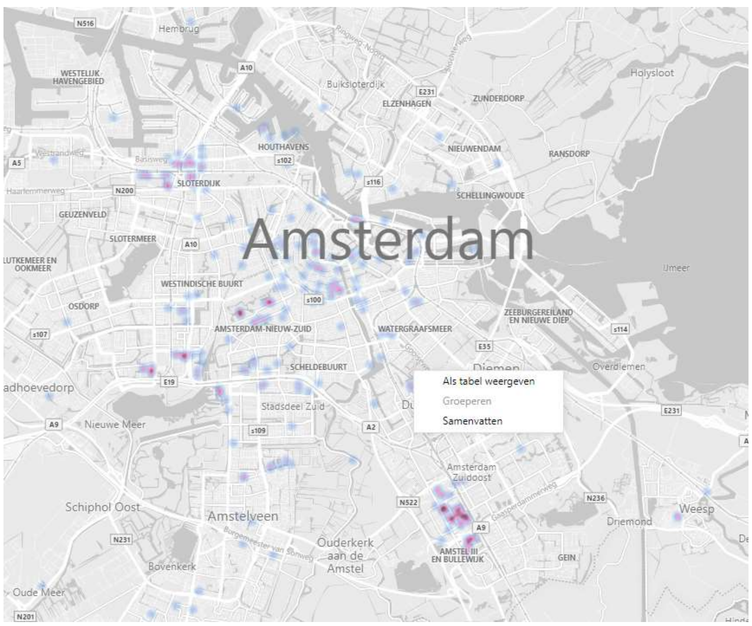

Figure 5: Transaction density in Amsterdam

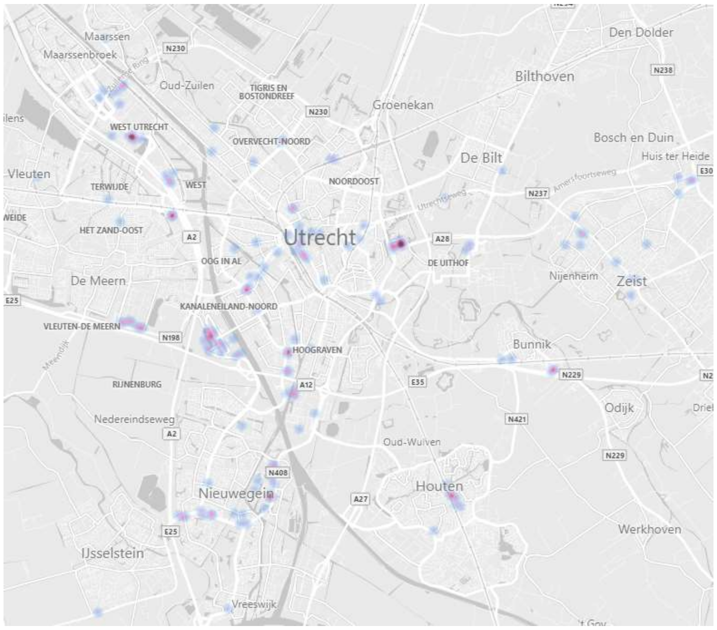

Figure 6: Transaction Density in Utrecht

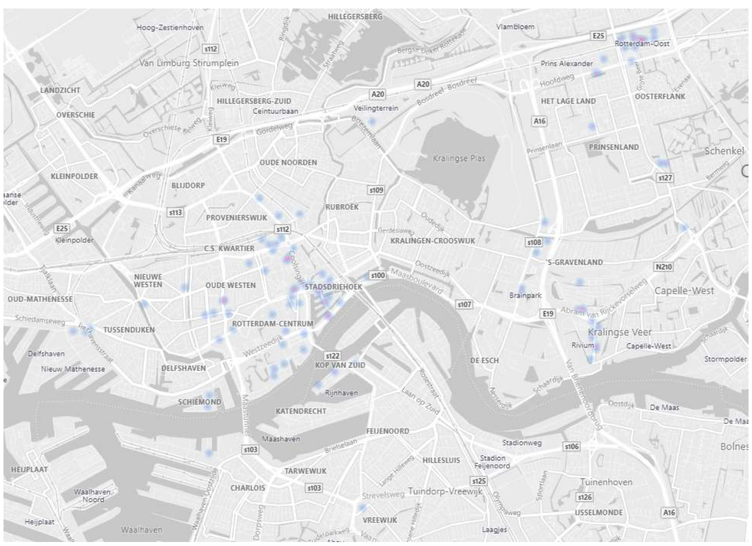

Figure 7: Transaction Density in Rotterdam

Figure 8: Transaction Density in Den Haag

Figure 9: Transaction Density in Eindhoven

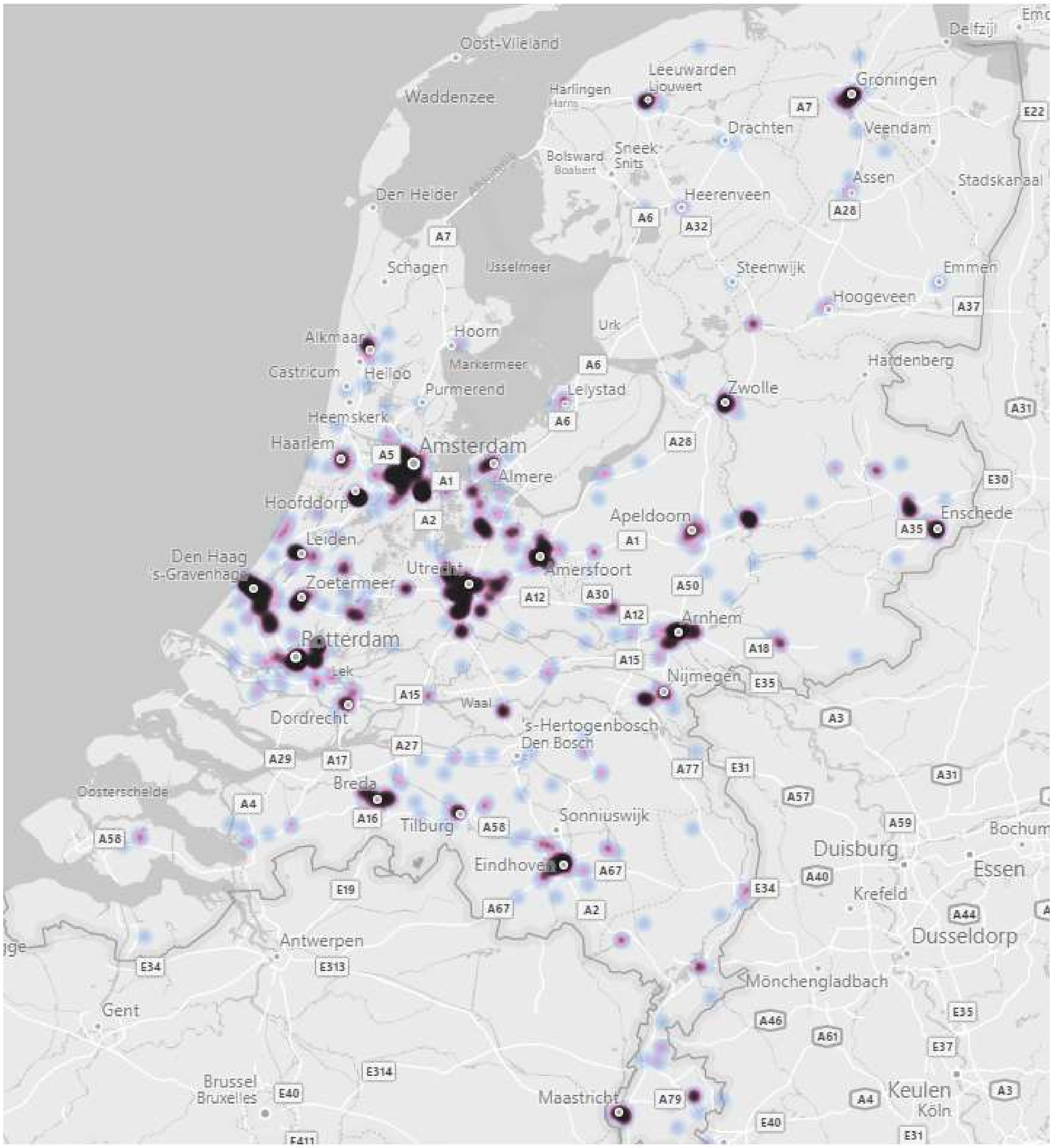

Figure 10: Transaction density in the Netherlands.

Table 6 Regression results with dependent variable LN(Transaction price)

VARIABLES	(1)	(2)	(3)
EPC A+ or better	0.662***	0.617***	
	(0.119)	0.114	
Only EPC A	0.274***	0.229***	
	(0.055)	(0.041)	
EPC A			0.241***
			(0.048)
EPC B	0.185***	0.140***	0.141***
	(0.060)	(0.047)	(0.047)
EPC C	0.068	0.021	0.019
	(0.058)	(0.044)	(0.044)
EPC E	0.019		
	(0.078)		
EPC F	0.089		
	(0.082)		
EPC G	0.106		
	(0.078)		
CONTROL VARIABLES			
SQUARE METRES	Yes	Yes	Yes
TRAIN STATION	Yes	Yes	Yes
HIGHWAY	Yes	Yes	Yes
VACANCY RATE	Yes	Yes	Yes
DUMMY VARIABLES			
LOCATION	Yes	Yes	Yes
TRANSACTION YEAR	Yes	Yes	Yes
CONSTRUCTION YEAR	Yes	Yes	Yes
CONSTANT	8.181***	8.252***	8.313***
	(0.164)	(0.157)	(0.156)
R-SQUARED	0.801	0.801	0.799
BIC	3841.53	3821.43	3830.42
JOINT F-TEST	8.86***	15.05***	16.45***
NUMBER OF VARIABLES	24	21	20

Standard errors in parentheses
*** p<0.01, **p<0.05, *p<0.1