PROPERTY
RESEARCH
TRUST

Occupier profile and the ESG agenda in commercial real estate

Dr Nan Liu
Dr Yuan Zhao
Professor Norman Hutchison
Mr Bowen Yan

FEBRUARY 2024

The Property Research Trust is a charity registered in the UK and regulated by the Charity Commission, registered number 1085587. Companies House registered number 4044051.

Registered office
5th Floor
167-169 Great Portland Street
London
W1W 5PF

Property Research Trust

Formerly the RICS Research Trust, we are an established grant-awarding charity, supporting research across the disciplines of land, real estate and construction. We have a strong track record of delivering and disseminating high-quality, independent knowledge and future thinking. We fund research globally. Find more about us here: **www.propertyresearchtrust.org**

DOI: 10.52915/DRAF4161

Authors

Dr Nan Liu
Dr Nan Liu is an Associate Professor at the Centre for Real Estate Research, University of Aberdeen Business School. Her research interests encompass urban studies; ESG in real estate; flexible working spaces; and tokenisation in real assets.

Dr Yuan Zhao
Dr Yuan Zhao is an Associate Professor of Real Estate Finance at the University of Reading. Her research areas cover a wide range of finance and real estate subjects, including mutual funds; portfolio optimisation; behavioural finance; risk management; crypto assets, and sustainability.

Professor Norman Hutchison
Norman Hutchison is Professor of Real Estate at the Centre for Real Estate Research, University of Aberdeen Business School. His current research focuses on senior housing; mortgages; city deals; and stakeholder engagement. Professor Hutchison is a Fellow of the Royal Institution of Chartered Surveyors.

Mr Bowen Yan
Mr Bowen Yan is a PhD candidate in real estate at the University of Aberdeen Business School. His doctoral project investigates ESG considerations in commercial real estate markets. Bowen served as a research assistant in this project.

Table of contents

Tables and Figures

Key messages

- **As global concerns around sustainability, corporate responsibility, and social impact continue to grow, understanding occupiers' ESG initiatives has become increasingly relevant to stakeholders in the real estate sector.**
- **The study contributes to the current discussion on ESG matters in real estate by evaluating how tenants' environmental, social and governance standards impact the London commercial space market.**
- **In general, publicly listed firms exhibit an upward movement in their ESG performance measures over the last 20 years.**
- **We demonstrate that tenants' ESG or CSR considerations play a role in their building choice and are among the factors that drive the demand for sustainable buildings in the office sector.**
- **Rental premiums for more sustainable buildings are evident in the London office sector, but the premium differs among occupiers with different ESG agenda. This suggests that while the income implications for investors are clear, building owners also need to consider the mix of tenants and weigh up the costs of implementing sustainable features against potential long-term savings and benefits.**
- **There is insufficient proof of green premiums in the retail and industrial sectors. Such absence of green premiums underscores the potential obstacles in enhancing building energy performance in these commercial real estate sectors and highlights the need for government interventions.**

Foreword

This report fills a gap in our knowledge about occupier characteristics with respect to ESG. By examining the profile of occupiers of commercial real estate, the authors draw important conclusions about the relationship between the characteristics of occupiers and sustainable choice, the bargaining power of tenants, as well as the influence of energy performance regulations and the covid pandemic.

The focus of the report on the London office, retail and industrial markets and its use of lease transaction data from CoStar and ESG scores from Refinitiv, means that its conclusions are robust and have 'real-world' applications in this and other major real estate markets.

The Trust is keen that the research we publish can be used by stakeholders and practitioners in meaningful ways. The range of conclusions in this report relating to demand for sustainable buildings, 'green' premiums, sector differences, property valuations, risk mitigation and tenant satisfaction and retention provide ample opportunity for practitioners to influence the implementation of real estate strategies on a day-to-day basis, to the benefit of the wider community.

On behalf of the Property Research Trust, I am delighted that we have been able to fund this latest addition to the body of research on these property sectors and I encourage practitioners and other readers to utilise its findings to the fullest extent. My thanks to the authors for their excellent work.

Rob Harris
Interim Chair, Property Research Trust

Executive summary

There is a gap in the existing environment, social and governance (ESG) literature in the real estate sector, where occupier characteristics with respect to ESG are overlooked. This report attempts to fill this gap by examining the profile of occupiers of commercial real estate. More specifically, it investigates the relationship between the characteristics of occupiers and sustainable building choice; evaluates the bargaining power of tenants with different ESG agendas; and examines whether there were changes in the above due to requirements of energy performance regulations and during the covid pandemic.

This research focuses on the London office, retail and industrial markets and utilises lease transactions from CoStar (www.CoStar.co.uk) and occupiers' ESG scores (including the overall score and three separate scores for each of the environment, social and governance pillars) from Refinitiv (www.refinitive.com) from 2002 to 2022.

An important finding is that there are differences in the outcomes between the office sector, the retail and industrial sectors.

In the office sector, we find that:

- Publicly listed tenants, which are more likely to disclose their corporate social responsibility (CSR) policies and therefore more likely to be ESG-conscious, are more likely to occupy a sustainable-labelled space (such as BREEAM certification).
- Tenants with stronger emphasis on corporate governance (reflected by higher governance pillar scores) are also more likely to choose a BREEAM-certified space.
- Our hedonic modelling results confirm a BREEAM-related rental premium of around 9% on average. This sustainable label-related premium is higher among non-listed firms than listed firms.
- The introduction of minimum energy performance regulation seems to have increased listed occupiers' bargaining power in rent negotiations due to the increased supply of more sustainable buildings.
- Listed firms' bargaining power is also shown to have been stronger during the covid period, as the demand for office space fell significantly.
- Tenants' overall ESG scores do not appear to affect the effective rent they pay in the hedonic estimation, while separate scores on the social and governance pillars do seem to have impacted rent during the covid period.

In the retail and industrial sectors we find:

- There is no statistically significant relationship between tenants' characteristics (being listed or their ESG scores) and their probability of occupying BREEAM-certified space.
- There is also no evidence of rent premiums related to BREEAM on average. However, unlike in the office sector, listed tenants appear to pay more for BREEAM in the retail sample, and separate scores on the social and governance pillars also seem to affect the effective rent on average.
- Regulations on minimum energy performance have not increased the probability of a space being BREEAM certified in the retail and industrial sectors, but listed retail tenants were more likely to occupy a BREEAM-certified building during covid.

The implications of this study for stakeholders and practitioners in the real estate sector are as follows:

- **Demand for sustainable buildings** Firms' ESG or CSR considerations play a role in their building choice and are among the factors that drive the demand for sustainable buildings. With the increasing focus on ESG, the desire among tenants for sustainable buildings could intensify, propelling the advancement of the sustainable construction and retrofit agenda. This also implies that the market is likely to become more polarised, as demand from occupiers decreases for properties that fall below a certain standard, leaving only those with higher energy performance in the market.
- **'Green' premium** The research shows rental premiums associated with sustainable office buildings, yet the extent of this premium varies among different tenants. This implies that while the income implications for investors are apparent, property owners must also take into account the diversity of tenants and carefully assess the cost of integrating sustainable elements against the possible future savings and advantages.
- **Sector differences** While our results show significant rental premium associated with sustainable buildings in the office sector, there is insufficient proof of similar green premiums in the retail and industrial sectors overall. This implies that without financial incentives, or further government intervention, it may be difficult to improve the energy efficiency of retail or industrial buildings.
- **Property valuation** Tenants' ESG ratings can affect their default risk, credit ratings, level of profit, and access to the capital market, thereby contributing to their covenant strength, which is a key consideration in property valuation.
- **Risk mitigation** Understanding occupiers' demand for sustainable buildings can further mitigate risks associated with regulatory changes, environmental liabilities, and changing market preferences.

- **Tenant satisfaction and retention** Meeting ESG expectations can contribute to higher tenant satisfaction and retention rates. Property managers and owners that prioritise sustainability and social responsibility are more likely to foster positive relationships with tenants, leading to longer lease durations and reduced vacancy rates.

Chapter 1
Introduction

Environmental, social, and governance (ESG) measures in the commercial real estate sector continue to grow in both industry and academic relevance. Environmental factors refer to the ecological aspects of real estate development and management, such as energy efficiency, water conservation, waste reduction, and the use of sustainable materials. As the built environment generates 40% of global annual carbon emissions (Architecture 2030, n.d.), real estate projects are expected to minimise their carbon footprint, a position promoted by both professional bodies (Sturgis, 2020) and regulators (Ministry of Housing, Communities & Local Government, 2021).

Social considerations emphasise the impacts of real estate on occupiers, local communities and broader society. This involves creating spaces that are safe, inclusive, and conducive to human wellbeing.

Governance focuses on the ethical and transparent management of real estate assets and operations. This includes responsible management of tenant relationships, ethical financial practices, and diversity and inclusion at all levels of decision-making within the real estate sector.

ESG is recognised as an opportunity as well as material risk for real estate (Cloutier, 2020; RICS, 2022) and affects various professionals, including project development and management, investor relations and funding, and tenant relations. Academic research on ESG in real estate predominantly focuses on the environmental aspects in building development, management and investment, with scholars investigating carbon footprint reduction through building technology and building management (Miller & Buys, 2008; Kibert, 2016) and the financial performance of green-labelled, or energy efficient buildings (see for example, Eichholtz, et al (2010); Fuerst & McAllister (2011a, b, and c); and Chegut et al (2014)).

Newell & Marzuki (2022) and Newell et al (2023) reflect on the importance of ESG to direct property investment decisions and focus on the benchmarking of ESG. With regard to indirect real estate investment, attention has been given to the improved access to the capital markets and enhanced financial flexibility associated with ESG disclosure among Real Estate Investment Trusts (REITs) (Brounen, et al, 2021; Feng & Wu, 2021).

While ESG issues have merited the attention of investors, developers, real estate managers, market professionals and policymakers alike, a key element that is pertinently overlooked in ESG considerations within real estate is the

role of users (Seyler & Mutl, 2019). Earlier research, based on qualitative data, shows that environmental considerations appear to have little impact on the building choice of occupiers (Sayce, et al, 2009), while others argue that the demand for green-labelled or energy efficient buildings could be driven by occupiers' corporate social responsibility (CSR) polices (Dixon, et al, 2009; Sayce, et al, 2009).

As the importance of ESG matters grows, there is a need to systematically examine tenants' characteristics in the commercial real estate sector. Against this backdrop, this project has the following research objectives:

- To examine and dismantle occupiers' ESG profiles over time.
- To investigate the driving forces of occupiers' demand of sustainable buildings.
- To evaluate the bargaining power of tenants with different ESG agendas.

Furthermore, we consider the potential impacts of regulations and the covid pandemic. The Energy Efficiency (Private Rented Property) (England and Wales) Regulations 2015 requires all commercially leased properties in England and Wales to have a minimum Energy Performance Certificate rating of E. Such a regulatory requirement could have potentially increased the supply of more energy-efficient buildings. Meanwhile, changes in work patterns as a result of the covid pandemic have led to increased adoption of remote work and flexible work arrangements, reduced office occupancy and increased focus on health and safety, all of which are likely to have an impact on demand. Our final research objective is therefore:

- To examine the potential changes in occupier's demand since the introduction of the minimum EPC rating requirement and during the covid pandemic.

Chapter 2
Sustainable buildings in commercial real estate in the UK

The main purpose of sustainable building certification is to recognise properties that meet specific sustainability criteria. For developers, the certification provides a structured framework and set of guidelines for creating sustainable and efficient buildings. For investors, it is often associated with rental or price premiums (further discussed in Section 3.1) and reduced risks associated with changing environmental regulations. For occupiers, sustainable buildings may have lower operational cost and provide healthier and more productive environments. This section provides an overview of the major sustainable certification and energy efficiency measures in the UK.

2.1 BREEAM

In 1990, the UK's Building Research Establishment (BRE) began the independent certification of the environmental performance of buildings in the UK. A commercial building can receive BRE Environmental Assessment Method (BREEAM) certification if it meets the minimum standards set by BRE in eight core dimensions: building management; health and wellbeing; energy efficiency; transport efficiency; water efficiency; material usage; pollution; and land use ecology. Each category is evaluated based on specific criteria, and the cumulative score determines the overall certification level.

BREEAM is a voluntary certification programme and offers multiple certification levels based on the achieved score. These levels include Pass, Good, Very Good, Excellent, and Outstanding, allowing buildings to be recognised for varying degrees of sustainability performance. BREEAM is adaptable to both residential and commercial properties. It can also be applied to various stages of a building's lifecycle, such as design, construction, and operation.

BREEAM certification therefore does not only indicate how potentially

sustainable a building is, it also serves as an indicator of the 'quality' of the building and building management.

2.2 LEED

LEED (Leadership in Energy and Environmental Design) is a green building certification system that originated in the US and is managed by the US Green Building Council (USGBC). While LEED is primarily associated with the US, it has gained international recognition and has been adapted for use in various countries, including the UK.

LEED certification can be pursued for both residential and commercial properties and assesses buildings across categories such as sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation in design. Each category has specific prerequisites and credits that contribute to the overall LEED score. Similar to BREEAM, LEED certification in the UK offers different levels of certification based on the total points achieved: Certified, Silver, Gold, and Platinum.

2.3 NABERS

NABERS UK (National Australian Built Environment Rating System) is an energy efficiency certification and rating system originating from Australia, and recently adopted by the BRE for office buildings in the UK. NABERS operates by measuring and rating the actual energy use of offices, helping building owners accurately track and communicate the energy performance of their buildings.

2.4 EPC

Unlike the voluntary schemes above, the Energy Efficiency (Private Rented Property) (England and Wales) Regulations 2015 made it unlawful for landlords to grant new leases on commercial premises from 1 April 2018 if the Energy Performance Certificate (EPC) rating was below an E. From 1 April 2023, all non-domestic private rented properties must have an EPC rating of E or above. The new minimum EPC requirement will therefore apply to any existing leases, not just new ones. There are exemptions, nevertheless properties must have an EPC when leased or sold.

An EPC can be prepared for an entire building or for a particular lease and is based on the characteristics of the space (such the fabric, age, and condition) and its services (such as heating, ventilation, lighting and renewable energy provision). An EPC rating contains numerical scores, which are typically converted to A+ to G scales, where a rating of A+ represents highest level of energy efficiency, and a rating of G indicates energy inefficiency.

Notably, the EPC does not provide information on the actual energy required to run the building or the associated levels of carbon emissions (Fuerst et al, 2013). Hence, 'the EPC is an assessment of potential energy performance rather than monitoring of actual performance' (Fuerst, et al, 2013, p374).

Due to data availability, this report focuses on BREEAM. At the time of writing, BRE shows that there are 1,399 offices, 330 industrial and 862 retail properties in London that have been assessed or certified to BREEAM standards.

Chapter 3
Demand for sustainable buildings

Despite the mixed results in the correlation between energy consumption and certified buildings (Turner & Frankel, 2008; Newsham, et al, 2009; Scofield, 2009; Jeong, et al, 2016; Kilcioglu & Zubizarreta, 2016; Qiu & Kahn, 2019), it is often argued that sustainable buildings have the potential to reduce tenants' operational costs through reduced energy use (Bartlett & Howard, 2000; Miller & Buys, 2008). Other reasons for occupier demand for sustainable labelled buildings include reputational considerations (Fombrun & Shanley, 1990); increased worker productivity; and employee satisfaction[1] (Thatcher & Milner, 2014; Leder et al, 2016). The combination of cost savings, improved performance and corporate image may align well with occupiers' corporate social responsibility (CSR) policies, resulting in a higher overall demand for sustainable-labelled buildings (Reed & Wilkinson, 2005; Eichholtz, et al, 2010; Szumilo & Fuerst, 2013).

3.1 Rent premiums

It is expected that some of these benefits discussed above will produce increased rental bids from tenants (Fuerst & McAllister, 2011b; Reichardt, et al, 2012; Livingstone & Ferm, 2017). A summary of existing empirical findings on sustainable label related rent premiums are presented in Table 1. As shown, existing studies predominately focus on the office sector. A wide range of rent premiums are evident in these studies. One possible reason for such variation is geographical and temporal differences. Eichholtz et al (2010) find that rent premiums are higher in smaller regions and lower in larger metropolitan areas. At country level, Costa et al (2018) find higher premiums in developing markets compared to developed countries. The authors suggest that the results reflect the relative scarcity of certificates and the lower sustainability standards in emerging economies.

Khan & Kotchen's (2010) and Reichardt et al (2012) note that rental premiums increase in sustainable labelled properties during a market boom, but experience a decline in economic downturn. Similarly, Szumilo & Fuerst

[1] *Notably, Thatcher and Milner (2016) find no association between green buildings and employees' wellbeing, job satisfaction, propensity to leave and organisational image.*

(2017) show significant temporal differences in rent premiums associated with sustainable labels and argue that such differences reflect the changes in demand for sustainable spaces.

Eichholtz et al (2013) and Fuerst & van de Wetering (2015), meanwhile, do not find weakened tenant demand for sustainable buildings during the period of economic decline. Eichholtz et al (2013) suggest that this may be an indication that the market places a premium on operational cost savings in a more efficient building, regardless of stage of the business cycle.

Table 1. Summary of empirical research on rent premiums on energy efficiency/labels

Authors	Sector	Market	Green measures	Rent premiums
Chegut et al (2014)	Office	London, UK	BREEAM	2%
Costa et al (2018)		Sao Paulo, Brazil	LEED	4-8%
Devine & Kok (2015)	Office	Canada & US	LEED	3.7-17.5%
			Energy Star	2.70%
			BOMA BESt[a]	-1%
			BOMA BESt & LEED	9.40%
Eichholtz et al (2010)	Office	US	Energy Star	3.30%
			LEED	No significant premium
			Either	2.8-3.5%
Eichholtz et al (2013)	Office	US	Energy Star	2.1-6.5%
			LEED	5.8-6%
			Energy Star or LEED	2.6-7.6%
Fuerst & McAllister (2011a)	Office	US	Energy Star	3-4%
			LEED	4-5%
			Both	9%
Fuerst & McAllister (2011b)	Office	US	Energy Star	4%
			LEED	5%
			Both	5%
Fuerst & McAllister (2011c)	Office, Retail, Industrial	UK	EPC	No significant premium
			BREEAM	No significant premium
Fuerst et al (2013)	Office	UK	EPC	11% premium of A-C rated properties compared to D rated
Fuerst & van de Wetering (2015)	Office	UK	BREEAM	23-26%
Gabe & Rehm (2014)	Office	Sydney, Australia	NABERS	No premium
Holtermans & Kok (2019)	Office	US	Energy Star	1.5-4%
			LEED	1.3-1.9%
			Both	2.2-4.6%
Kilcioglu & Zubizarreta (2016)	Not specified	US	LEED or Energy Star	3.30%
Kok et al (2012)	Office	US	Energy Star	5.6-9.8%
			LEED	5-9%
Newell et al (2014)	Office	Australia	NABERS	2.3-6.7% among the higher rated properties

Onishi et al (2021)	Office	Tokyo, Japan	CASBEE[b], DBJ[c]	2.6-5.4%
Ott & Hahn (2018)	Office	Europe	BRREEAM, or LEED, or DGNB[d] or National certificate	No significant premium
Pivo & Fisher (2010)	Office	US	Energy Star	5.20%
Reichardt (2014)	Office	US	Energy Star	2.4-4.8%
			LEED	3.3-9.4%
			Both	10.20%
Reichardt et al (2012)	Office	US	Energy Star	3.3-6.1% in 2004-2007, insignificant in 2008
			LEED	No significant premium
Robinson & McAllister (2015)	Office	US	Energy Star	1.5-2.5%
			LEED	5.2-12.3%
			Both	3-15.7%
Robinson et al (2017)	Office	US	Energy Star	1.60%
			LEED	10.30%
Szumilo & Fuerst (2014)	Office	US	Energy Star	7-8%
Szumilo & Fuerst (2017)	Office	US	Energy Star	0.6%, but varies temporally
Veld & Vlasveld (2014)	Retail	The Netherlands	Energy Indexe	No significant premium
Wiley et al (2010)	Office	US	Energy Star	15-18%
			LEED	7-9%

[a]BOMA (the Building Owners and Managers Association) launched their Building Environmental Standards (BESt) in 2005 for existing buildings in North America.

[b]CASBEE (Comprehensive Assessment System for Built Environment Efficiency) is a green building certification initiative launched by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) in Japan in 2001.

[c]The MLIT also established the Building-Housing Energy Efficiency Labelling System (BELS) to certify the energy consumption performance (energy-saving performance) of buildings.

[d]The DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen) certification system is a rating tool for the built environment devel-oped by the German Sustainable Building Council.

[e]Energy index is a score calculated a formula that takes several energy efficiency measures of the property into account.

Chegut et al (2014) further investigate the overall supply of sustainable buildings and its impact on the sustainable-label related rent premiums. They find that as the competition for sustainable buildings increases, rents also increase, but such competition decreases the marginal effect of certification. Using EPC rating as an energy efficiency measure, Fuerst et al (2013) conclude that A-C-rated buildings achieve significantly higher rent than buildings with an average EPC rating (level D). However, this effect is limited to newer buildings. Others' research shows lower rent premiums of green labels among large-sized new buildings (Onishi et al, 2021).

There is also evidence that rent premiums only exist in low- and mid-value buildings (Robinson & McAllister, 2015). Robinson et al, (2017) show that green features[2] command significant rental premiums independent of green labels. The authors conclude that the additional LEED-related rent premium also conveys a brand premium that persists beyond the attributes alone.

From an investor's perspective, green-label related rent premiums could

[2]*Such as access to public transit, natural light, premium heating, ventilation and air conditioning (HVAC) systems, an onsite fitness facility, electric car charging, water conservation, and access to services.*

act as a market incentive to invest in efficient buildings and features. Furthermore, as mentioned previously, certifications can be seen as an indication of the quality of asset management and the manager's attitude towards optimising improvements (Asensio & Delmas, 2017). Not investing in energy certification may signal an asset owners' preference to prioritise short-term returns over long-term sustainability (Szumilo & Fuerst, 2017).

Gabe & Rehm (2014), Fuerst & McAllister (2011c) and Miller et al (2008), on the other hand, show no rent premiums associated with sustainable labels in certain office real estate markets. Similarly, Veld & Vlasveld (2014) find no rent premiums in green-labelled buildings in the retail market. Ott & Hahn (2018) analyse offices across Europe and their results show that having a green certificate does not necessarily result in rent premiums – although they are evident with higher energy label ratings (i.e., very good or above). Both the significance and magnitude of such rent premiums are reduced when controls for 'super trophy'[3] buildings are included in the regression.

There are a number of potential reasons for the lack of willingness to pay (WTP) for energy efficiency/sustainable labels. Fuerst & McAllister (2011a) argue that while labelling may be interpreted as a method of mitigating market failure resulting from information asymmetry, such mitigation only works if the labels provide a credible signal of attributes of superior environmental performance.

Information asymmetry could be a potential concern for tenants if sustainable features of buildings are overpriced and the actual environmental performance is not known in advance by the tenants (Reichardt et al, 2012). This could be particularly relevant to EPC measures. As EPC ratings only indicate the intrinsic energy performance of the building based on its design and features, there might be uncertainty as to the cost-saving potential in operation, which may in turn lead market participants to discount the information expressed by the EPC rating (Fuerst & McAllister, 2011c). Furthermore, the lack of WTP for sustainable-labelled buildings could be due to the relatively small energy costs compared with the overall operational costs (Fuerst & McAllister, 2011c), although this may have changed since energy prices have increased significantly.

3.2 The link between sustainable buildings and occupiers' ESG

Despite evidence of rent premiums in sustainable-labelled buildings, earlier studies suggest that environmental considerations appear to have little impact on occupiers' building choice (Sayce et al, 2006), and not all tenants with sustainable business mission statements were able to secure green space or were willing to pay for it (Miller et al, 2008). Levy & Peterson (2013) conclude that there was no single overarching reason as to why organisations choose to embrace sustainable practices and locate in sustainable buildings in Auckland, but the authors find that larger tenants were influenced more

[3]*These buildings tend to feature high-quality fixtures and fittings, distinctive architecture, considerable height, larger-than-average size, and a low yield.*

by their CSR policies and the smaller ones focused more on energy efficiency. Using an experiment, Jang et al (2018) show that a green building certification increases tenants' willingness to rent, and such willingness is particularly higher among tenants with higher levels of eco-friendliness.

The demand for sustainable buildings could be driven by occupiers' CSR polices, evident in qualitative studies such as Dixon et al (2009) and Sayce et al (2009). Quantitative studies also show indirect evidence of the positive relationship between CSR policies and the demand for sustainable buildings. For example, Robinson et al (2016) show that tenants working for publicly listed companies are more likely to state a WTP for green-labelled buildings, as listed companies are likely to publish/disclose their CSR policies. Chegut et al (2014) find that financial service firms, advertising and insurance sectors are the dominant users of green space. This is in line with the argument from Cajias et al (2014) that firms' CSR strategies differ significantly across industry sectors: for instance, customer-orientated companies put more emphasis on CSR than asset-driven sectors.

In summary, despite the mixed conclusions in the existing studies, as the emphasis on the green agenda grows, it is expected that corporate users will increasingly place importance on occupying environmentally certified space (Turban & Greening, 1997).

3.3 ESG and tenants' bargaining power

Section 3.2 summarises the potential reasons for occupiers' choice of sustainable-labelled buildings, which are predominately related to CSR policies. This study also investigates whether tenants' ESG measures improve their bargaining power when it comes to negotiating rent.

Academic studies that examine tenants' bargaining power in commercial real estate are scarce. Traditionally, rent is modelled using the 'search and bargaining' framework with a focus on supply and demand (Wheaton, 1990), and the characteristics of tenants tend not to be considered. However, due to the private nature of the markets and relatively illiquid nature of the assets, the rents we observe are the outcomes of individual landlord and tenant negotiations.

If tenants were homogenous, it would be possible to determine the optimal monopoly rent given a landlord's market power (Barker, 2003). In reality, tenants are different and hence have different bargaining power. In the retail sector, for example, the overall appeal of a property is largely determined by anchor tenants. Loss of an anchor tenant can lead to a significant decline in the overall rent (Gatzlaff, et al, 1994) and anchor tenants pay significantly lower rent than non-anchor ones (Sirmans & Guidry, 1993; Gerbrich, 1998). In a recent study focusing on the benchmarking of ESG in real estate investment by Newell et al (2023), the survey data reveals that tenants in the 'social' space (i.e. tenant satisfaction, the need for real estate managers to create a

community) has become a key consideration for some real estate investors.

Anecdotally, tenants with higher ESG scores may have stronger bargaining power for the following reasons:

1. Landlords may view companies with high ESG scores as desirable tenants due to their alignment with sustainable practices. Having such tenants can enhance the overall reputation of the property and make it more appealing to other potential tenants that also prioritise sustainability.

2) Also related to the reputation of the property, companies with high ESG scores, particularly higher emphasis on 'social', often contribute positively to the local community. Landlords may appreciate tenants that engage in community development, social initiatives, and environmental conservation efforts, as these activities can enhance the overall appeal of the property.

3) Companies that prioritise ESG factors are often more resilient in the face of environmental and social risks. Landlords may see such tenants as less likely to cause damage or disruptions, thus reducing potential risks associated with property management.

4) ESG-driven companies often demonstrate a commitment to long-term sustainability. Landlords may prefer tenants that are likely to maintain a stable and responsible presence in the property, reducing the risk of vacancies and turnover.

5) Stronger bargaining power may be reflected in incentives. Landlords may be more willing to offer incentives to ESG-conscious tenants to attract and retain them.

6) ESG-focused companies tend to value responsible and ethical business relationships, which may align with the landlord's interest in maintaining positive and respectful interactions with tenants.

Some of these reasons are directly linked to tenants' covenant strength, which is a key determinant in real estate pricing and a major risk consideration in real estate investments. Covenant is typically measured by default risk and credit scores (Adair & Hutchison, 2005; Hutchison, et al, 2008; Hutchison, et al, 2011; Crosby, et al, 2016). Evidence shows that higher ESG ratings are associated with lower default risk (Atif & Ali, 2021; Li, et al, 2022), higher credit ratings (Bhojrag & Sengupta, 2003; Ashbaugh-Skaife, et al, 2006; Weber, et al, 2010; Attig, et al, 2013), higher level of profit (Brogi & Lagasio, 2019; Giese, et al, 2019; Yoo & Managi, 2022), and better access to the capital market (Feng & Wu, 2021; Raimo, et al, 2021). Hence, ESG-driven companies are likely to have stronger covenant.

There are a few studies which examine covenant in the context of rent negotiation in the retail sector. Stores with lower default risk are reported to pay lower rent (Benjamin, et al, 1990; Benjamin, et al, 1992), while others argue that retail tenants with lower default risk also have higher expected

profits that will provide more economic rents that can be paid to acquire the space. For example, companies with stronger financial stability may pay higher premiums to secure the more prominently and conveniently located units (Tay, et al, 1999).

3.4 Covid and demand for commercial real estate

In the UK, the rapid transition to remote working at the beginning of the pandemic fundamentally altered employers' and employees' perceptions of office-based work (Fiorentino, et al, 2022). Empirical studies show that during the covid period, commercial rent fell significantly in urban centres (Rosenthal, et al, 2022) and corporate tenants reduced their office floor space and demanded more flexibility in leases (Tanrıvermiş, 2020; Oladiran, et al, 2023). Fiorentino et al (2022) conclude that working from home is likely to become a permanent feature.

On the one hand, such shifts in office demand are likely to concentrate on large urban centre locations, while the demand for rented satellite office space on the other hand, is likely to increase (Hensher, et al, 2023). The pandemic, therefore, has created both short-term and long-term shifts in demand for offices with consequent impacts in both occupation and investment markets in different geographical locations.

The retail sector shares a similar story during the covid pandemic, with both occupancy and rental levels significantly adversely affected by the lockdowns and temporary closures of retail premises. For instance, rental decline was reported as high as 30% in 2020 in the Asia-Pacific region (Allan, et al, 2021). In contrast, the industrial sector, particularly logistics properties and distribution centres, were the most resilient during the pandemic, with growth in both the rate of sales and rents (Wen, et al, 2022). This growth has, in turn, encouraged capital flows into this sector (Allan, et al, 2021).

The pandemic emphasised the importance of indoor air quality and increased the awareness of health and wellbeing (Roh, et al, 2021; Ortiz & Bluyssen, 2022); highlighted the role of real estate management in the trade-off between health and safety and financial returns (Parker, 2020); and tested the crisis management capabilities of real estate owners/managers (Hao, et al, 2020). Despite these changes, there is very little discussion in the literature on how the demand for sustainable certified buildings has changed due to covid.

BREEAM certification does not only consider environmental factors, but is also based on a holistic assessment of social and governance measures. Anecdotally, the increased emphasis on health and wellbeing during Covid could lead to increased demand for sustainable labelled buildings. The final part of this report aims to provide some empirical evidence on this.

Chapter 4
Data

The main dataset used in this research consists of commercial leases collated from CoStar's lease transactions of offices in London from January 2002 to December 2022. We also collated leases of retail and industrial properties in London from January 2012 to December 2022[4]. Our samples consist of 18,596 office leases, 6,663 retail leases and 2,927 industrial leases. The geographical area of the study is shown in Figure 1 and a list of submarkets[5] can be found in Table 2.

Table 2: List of submarkets

Submarket	Frequency	%
City Fringe	1,615	7.96
London West	1,437	7.08
Mayfair	1,371	6.76
City Core North	1,338	6.6
City Core East	1,239	6.11
Southbank	1,036	5.11
Noho	885	4.36
Holborn	864	4.26
Northern Fringe	845	4.17
Clerkenwell	733	3.61
Marylebone	731	3.6
London South	720	3.55
Covent Garden	705	3.48
City Core West	680	3.35
St James's	676	3.33
Soho	675	3.33
Westminster	546	2.69
London East & Northeast	527	2.6
London Northwest	464	2.29
Bloomsbury	452	2.23
Victoria	425	2.1
Southern Fringe	406	2
Western Fringe	399	1.97
Other inner London	374	1.84

[4]The retail and industrial samples cover a shorter period due to the limited number of observations in the early years.
[5]Submarkets on the outskirts of the city with smaller number of observations are combined into 'submarket clusters' as indicated by CoStar.

Eastern Fringe	372	1.83
London Docklands	287	1.41
Knightsbridge	215	1.06
King's Cross & Euston	152	0.75
Paddington	117	0.58
Total	**20,286**	**100**

Source: CoStar

Figure 1. London and commercial real estate submarkets (source: CoStar)

Table 3 shows all the variables and their descriptions used in the analysis. Physical attributes include the total floor space leased; the total net internal floor area of the building (NIA), from which the percentage of floor space in the building occupied by the tenant is calculated; the floor level of the occupied space[7]; the year of construction and renovation. Whether there are lifts, the number of parking spaces and the construction materials are also recorded. Lease details such as effective rent, lease length, break clauses, and repair and insuring obligations are also collated from CoStar. We further convert postcodes to geocodes (longitudes and latitudes) using batch geocoding website www.doogal.co.uk.

[7]*If a tenant occupies multiple floors, we use the highest floor.*

Table 3: Variables and descriptions, CoStar data and Refinitiv ESG scores

Variable name	Description
Lease characteristics	
effectiverent	Effective Rent per square foot per year
size	Total square feet leased
lease_totalNIA	Ratio between leased floor space and total building floor space
highestflooroccupied	Highest floor occupied
term	Lease length measured in months
FRI	= 1 if it is a full repairing and insuring lease
break	= 1 if there is a break; otherwise = 0
newlease	= 1 if it is a new lease; = 0 if it is a renewal
headlease	= 1 if it is a head lease; = 0 if it is sub lease
signyear	The year lease contract signed
rentfreemonth	Rent free (month)
TOM	Time on the market (in months)
Building characteristics	
postcode	Postcode, used to convert to geocode
lat	Latitude
lng	Longitude
submarket	CoStar predefined submarket, used for fixed effect
building_NIA	Building's total NIA (SF)
building_storeys	Number of storeys within the building
costar_1star	= 1 if CoStar rating is 1; = 0 otherwise
costar_2star	= 1 if CoStar rating is 2; = 0 otherwise
costar_3star	= 1 if CoStar rating is 3; = 0 otherwise
costar_4star	= 1 if CoStar rating is 4; = 0 otherwise
costar_5star	= 1 if CoStar rating is 5; = 0 otherwise
costar_0star	=1 if CoStar rating is 6; = 0 otherwise
masonry	= 1 if construction type is masonry, = 0 otherwise
metal	= 1 if construction type is metal; = 0 otherwise
r_concrete	= 1 if construction type is reenforced concrete; = 0 otherwise
steel	= 1 if construction type is steel; = 0 otherwise
wood_frame	= 1 if construction type is wood frame; = 0 otherwise
parking	Number of parking spaces
lifts	Whether the property has lift(s)
BREEAM	= 1 if BREEAM certified; = 0 otherwise
yearbuilt	Building completion year
yearrenovation	Year of renovation
Age	Calculated using either year built or year renovation
Tenant characteristics	
Listed	= 1 if it is a publicly listed company; = 0 if private company
Communication services	= 1 if tenant's industry is communication services; = 0 otherwise
Consumer discretionary	= 1 if tenant's industry is consumer discretionary; = 0 otherwise
Consumer staples	= 1 if tenant's industry is consumer staples; = 0 otherwise

Energy & utilities	= 1 if tenant's industry is energy and utility; = 0 otherwise
Financials	= 1 if tenant's industry is financials; = 0 otherwise
Healthcare	= 1 if tenant's industry is healthcare; = 0 otherwise
Industrials	= 1 if tenant's industry is industrials; = 0 otherwise
Information technology	=1 if tenant's industry is information technology; = 0 otherwise
Non profit	=1 if tenant's industry is non-profit organisations; = 0 otherwise
Real estate	= 1 if tenant's industry is real estate; = 0 otherwise
ESG	Tenant's Refinitiv ESG scores
E	Tenant's Refinitiv scores for the environmental pillar
S	Tenant's Refinitiv scores for the Social pillar
G	Tenant's Refinitiv scores for the Governance pillar

To quantitively measure a tenant's ESG, we use the company names and trading tickers of the tenants in the CoStar sample as identifiers and match lease data to Refinitiv ESG ratings and Bloomberg ESG disclosure scores. Refinitiv ESG rating is a performance measurement, evaluating a company's impact on the environment, its relationship with its employees, customers, communities and other stakeholders, and the structure and practices that guide how a company is managed and controlled. Bloomberg ESG scores assess how well companies are disclosing their ESG practices to the public. If a tenant is a private company with a parent company that is publicly listed, the parent company's ESG scores are used, as both Refinitiv and Bloomberg only report on currently listed companies.

In the office sample, out of the 1,595 leases with tenants being publicly listed companies, 993 can be identified to have Refinitiv ESG scores[7]. In the retail and industrial samples, similar proportions of tenants can be identified using Refinitiv scores. Unfortunately, very few tenants can be matched to the Bloomberg ESG dataset, hence we are not able to include Bloomberg's measures. Notably, some of the CoStar information cannot be batch downloaded and we manually collected this information from each lease transaction description. The matching between CoStar and Refinitiv also involved manual checks. Descriptive statistics can be found in Table 4.

[7]*These refer to the number of lease transactions in which tenants' Refinitiv ESG scores can be identified.*

Table 4: Descriptive statistics, all three sectors

	Office			Retail			Industrial		
Variable name	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**
effectiverent	18,596	43.32	23.09	6,663	61.12	75.58	2,927	11.50	5.39
size	18,596	7,773	21,807	6,663	2,793	5,536	2,927	9,234	13,830
lease_totalNIA	18,596	0.16	0.19	6,663	0.27	0.31	2,927	0.28	0.23
highestflooroccupied	18,366	3.19	3.94	6,580	0.16	1.01	2,622	0.47	0.61
term	18,596	92.52	51.11	6,663	136.59	55.64	2,927	102.63	45.16
FRI	18,596	0.67	0.47	6,663	0.67	0.47	2,927	0.74	0.44
break	18,596	0.46	0.50	6,663	0.39	0.49	2,927	0.50	0.50
newlease	18,596	0.92	0.28	6,663	0.84	0.37	2,927	0.86	0.35
headlease	18,596	0.86	0.34	6,663	0.94	0.23	2,927	0.97	0.16
rentfreemonth	18,596	6.12	9.39	6,663	3.69	6.23	2,927	4.06	6.49
building_NIA	18,596	83,275	147,330	6,663	161,116	400,769	2,927	38,170	47,212
building_storeys	18,580	8.02	6.29	6,629	5.39	4.14	2,915	1.87	0.85
costar_1star	18,596	0.00	0.02	6,663	0.00	0.03	2,927	0.01	0.09
costar_2star	18,596	0.03	0.17	6,663	0.19	0.39	2,927	0.26	0.44
costar_3star	18,596	0.37	0.48	6,663	0.47	0.50	2,927	0.69	0.46
costar_4star	18,596	0.41	0.49	6,663	0.28	0.45	2,927	0.04	0.20
costar_5star	18,596	0.05	0.21	6,663	0.07	0.25	2,927	0.00	0.02
costar_0star	18,596	0.14	0.35						
masonry	18,455	0.59	0.49	6,663	0.62	0.48	2,927	0.21	0.41
metal	18,455	0.00	0.03	6,663	0.00	0.01	2,927	0.02	0.13
r_concrete	18,455	0.19	0.39	6,663	0.12	0.32	2,927	0.02	0.12
steel	18,455	0.22	0.42	6,663	0.23	0.42	2,927	0.74	0.44
wood_frame	18,455	0.00	0.04	6,663	0.00	0.02	2,927	0.00	0.03
parking	18,596	13.44	100.42	6,663	343.55	1114.72	2,927	16.90	24.39
lifts	18,596	0.74	0.44	6,663	0.35	0.48	2,927	0.03	0.16
age	18,406	43.86	61.24	6,039	63.53	56.38	2,821	30.24	21.94
Listed	17,582	0.09	0.28	6,241	0.15	0.36	2,722	0.10	0.30
communication services	16,431	0.02	0.13	5,947	0.05	0.23	2,562	0.02	0.14
consumer discretionary	16,431	0.02	0.15	5,947	0.08	0.27	2,562	0.01	0.09
consumer staples	16,431	0.07	0.25	5,947	0.64	0.48	2,562	0.38	0.48
energy & utilities	16,431	0.02	0.13	5,947	0.00	0.03	2,562	0.01	0.10
financials	16,431	0.18	0.38	5,947	0.02	0.15	2,562	0.00	0.06
health care	16,431	0.04	0.19	5,947	0.02	0.14	2,562	0.01	0.10
industrials	16,431	0.49	0.50	5,947	0.16	0.36	2,562	0.53	0.50
information technology	16,431	0.09	0.28	5,947	0.01	0.11	2,562	0.03	0.16
non profit	16,431	0.01	0.12	5,947	0.00	0.02	2,562	0.00	0.07
real estate	16,431	0.07	0.26	5,947	0.02	0.15	2,562	0.01	0.10
BREEAM	18,596	0.17	0.38	6,663	0.07	0.26	2,927	0.03	0.17
ESG	993	49.85	17.73	662	52.12	18.14	226	52.19	17.69
E	966	52.74	29.69	662	60.93	26.56	226	54.89	25.6
S	966	58.58	22.26	662	64.18	22.76	226	53.26	22.85
G	965	58.34	22.71	662	56.81	21.80	226	60.7	20.84

Chapter 5
Occupiers' ESG profiles over time

This section aims to provide an overview of occupiers' ESG profiles over time, including the overall Refinitiv ESG scores, as well as the separate scores for each of the three pillars. Refinitiv's considerations of each pillar are shown in Table 5.

Table 5: Refinitiv ESG pillars and themes (Ehlers, et al, 2022, p10)

Pillars	Themes
Environmental	
(1) Emissions reduction	Emissions, waster, biodiversity, environmental management systems
(2) Innovation	Product innovation, green revenues, research and development and capital expenditures
(3) Resource use	Water, energy, sustainable packaging, environmental supply chain
Social	
(1) Community	Public health, business ethics
(2) Human rights	Respect for fundamental human rights conventions
(3) Product responsibility	Responsible marketing, product quality, data privacy
(4) Workforce	Diversity and inclusion, career development and training, working conditions, health and safety
Governance	
(1) CSR strategy	Corporate Social Responsibility strategy, ESG reporting and transparency
(2) Management	Structure (independence, diversity, committees), compensation
(3) Shareholders	Shareholder rights, takeover defences

The London real estate markets are diverse and host a wide range of occupiers from different industries. We first look at all firms whose ESG scores can be identified using the Refinitiv ESG database and construct time series of ESG scores of global firms at aggregated levels. Since not all firms are occupiers in the London market, we then focus on the ESG scores of the occupiers in our samples[8].

The fluctuations in the ESG scores suggest that market attitude towards ESG activities changes over time (Bird, et al, 2007). Figure 2 provides an overview of the average ESG and environment (E), social (S), and governance (G) separate scores of all firms between 2002 and 2022. As shown, there has been an increase in ESG scores among these firms over the time period.

[8]*The shortcoming of examining occupiers with ESG scores in the sample is that the ESG trends are generalised over a relatively small samples of firms, as not every single occupier's ESG profile can be identified.*

The average scores for the S and G pillars follow a similar pattern as the overall average ESG scores, with the G pillar having the highest scores, indicating a strong emphasis on the internal structure, policies, and decision-making process among these listed companies. Notably, the environmental pillar score, which focuses on how companies address and manage their environmental impact, behaved differently.

In the early 2000s, environmental regulations and compliance were primarily seen as a cost item (Porter & van der Lind, 1995), hence many firms focused on meeting the minimum regulatory standards for environmental protection. This might be reflected in the relatively low scores in the E pillar. Between 2004 and 2014, international awareness of environmental issues continued to grow, particularly related to climate change. Governments worldwide began introducing stricter environmental regulations and standards[9]. Companies responded by taking measures to comply with these regulations, which often led to improved environmental performance.

Interestingly, on average, the scores for the E pillar decreased between 2014 and 2018. A possible explanation is that ESG score publishers became conservative and stricter after economic recessions or booms (Bolton, et al, 2012; Alp, 2013; Baghai, et al, 2014).

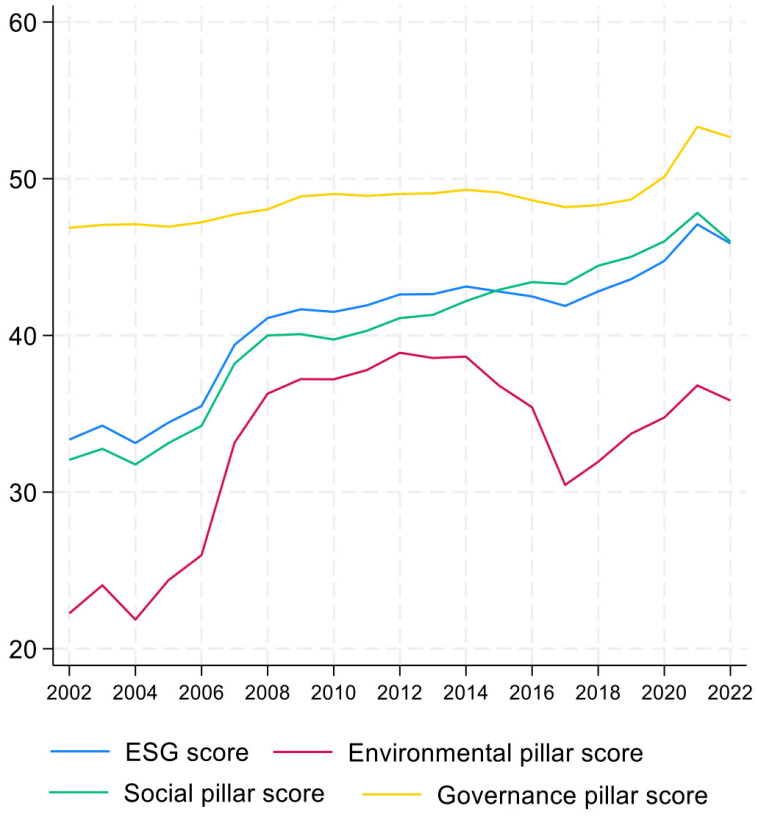

Figure 2: The average ESG scores and the average scores for each pillar for all firms, 2002-2022 (Source: Refinitiv)

[9]For example, the number of organisations that are signatories of the United Nations Principles for Responsible Investment (UNPRI) continues to grow. Corporations listed on the London Stock Exchange are required to report their levels of greenhouse gas emissions (GHG) based on the 'Quoted companies GHG reporting' rules issued in 2013. Chinese firms have been required to disclose environmental information according to the Environmental Information Disclosure Act issued by the Chinese government in 2008. In 2012, Mexico passed the General Law on Climate Change, which sets requirements for mandatory emissions measurement and reporting. Companies in the European Union (EU) started adapting to the EU Non-Financial Reporting Directive issued in 2014 (Yu, et al, 2018).

Figure 3 shows the aggregated ESG scores of firms in four countries with the largest number of listed firms: the US, China, UK and India. Variations of ESG scores in these countries could be due to the differences in cultural, regulatory and economic factors (Tayan, 2022). From a regulatory perspective, there are no universally agreed ESG reporting standards – some countries have mandatory regimes for reporting, while others adopt a voluntary framework.

The transition of the ESG reporting from a voluntary to a mandatory regime could stimulate companies to become more socially responsible and pursue better ESG performance (Cupertino, et al, 2022). The US, for example, despite being the first market to push for sustainable investing and being a pioneer in the field (Zhang, et al, 2021), lacks mandatory ESG reporting and disclosure regulations (Cicchiello & Marrazza, 2022). The UK government, on the other hand, supported the Task Force on Climate-related Financial Disclosures (TCFD) framework and implemented the EU's Non-Financial Reporting Directive (NFRD) in 2014.

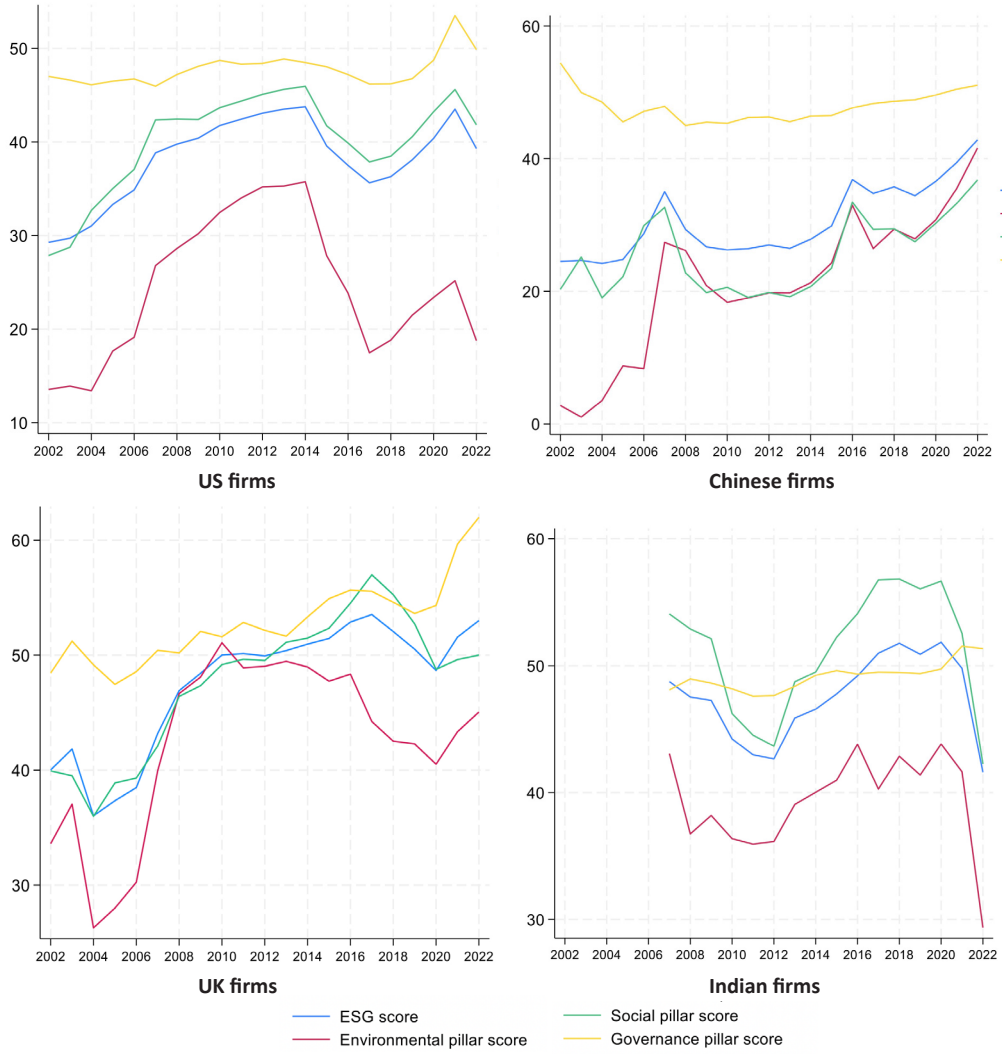

Figure 3. ESG trends by country (Source: Refinitiv)

Figure 3 also shows predominately upward trends in ESG scores for China. Academic studies show Chinese firms with higher ESG performance have fewer financial constraints, lower stock price crash risk, higher labour productivity (Deng, et al, 2023), and lower default risk (Li, et al, 2022). A recent survey of Chinese firms shows that companies are actively expanding their ESG capabilities and developing frameworks to incorporate ESG into their organisations (Fintech Global, 2023).

The assessment of Indian firms' ESG started in 2006. There was a significant, but short, decrease in environmental scores after the GFC in 2007, followed by a significant increase between 2012 and 2021. Despite the empirical evidence of long-term value associated with ESG disclosure among Indian firms (Mulchandani, et al, 2022), there are concerns over data reliability and the lack of evidence on the positive relationship between ESG scores and firms' financial performance in India (Sachin & Rajesh, 2022).

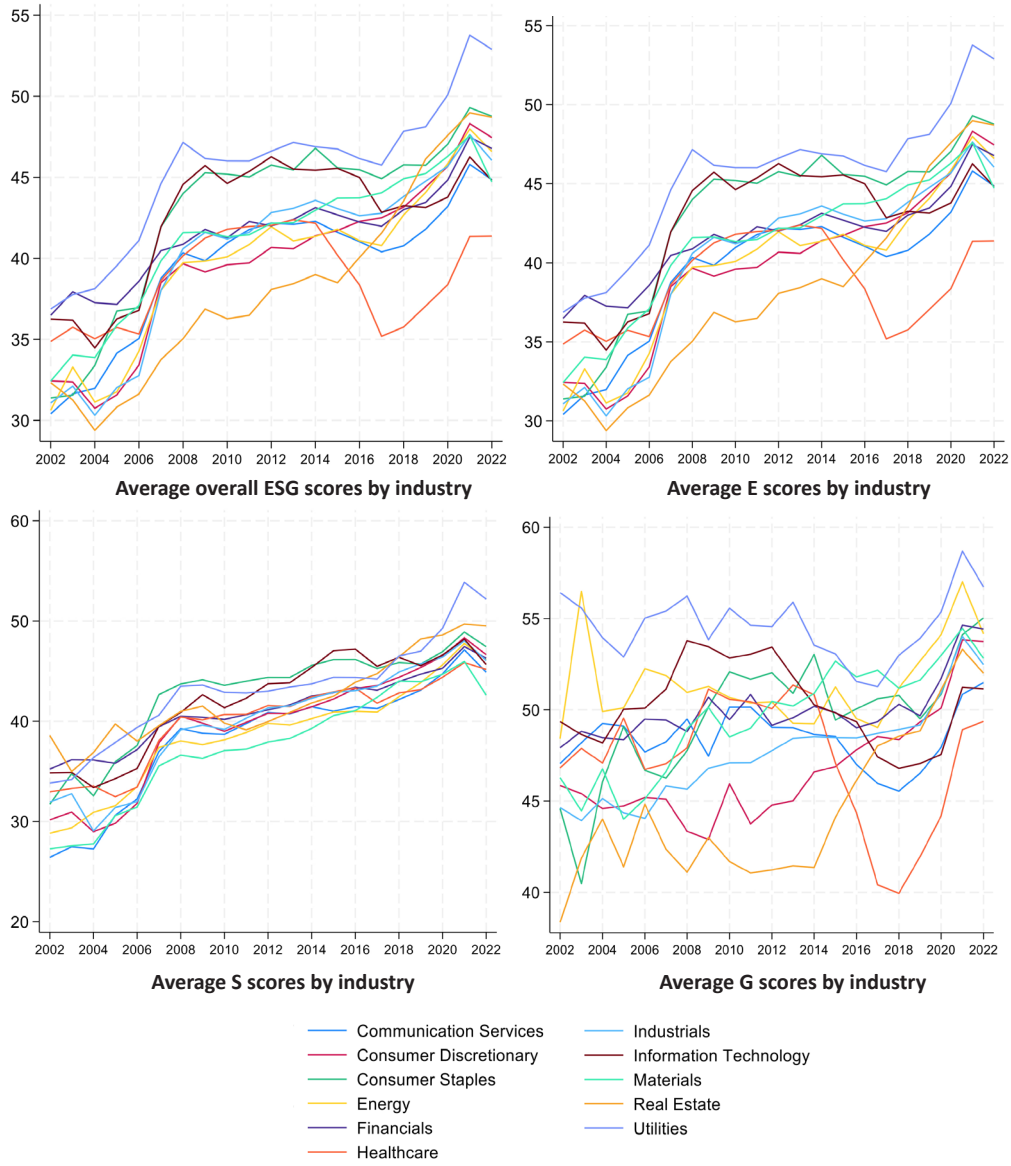

Figure 4. Average ESG scores by industry (Source: Refinitiv)

Figure 4 further dissembles ESG scores by industry. As shown, the variations in aggregated ESG scores across industry sectors are predominately driven by differences in the E and G pillars. Research shows that ESG performance and disclosure do not benefit corporations in different industry sectors equally (Hoepner & Yu, 2010; Baron, et al, 2011; Arian, et al, 2022). Such industrial differences could result in the different level of emphasis on each pillar, and thereby lead to different scores among industries.

Notably, high-emission industries such as the energy and utilities sectors have relatively high scores in the E and G pillar, whereas financial and healthcare sectors have relatively low scores in these pillars in recent years. Ehlers et al (2022) explain that energy firms tend to report on their emissions policy, therefore high carbon emissions can be partly compensated by measures taken by the company. Firms in the healthcare and financial sectors often do not report emissions data, as they are less concerned about these issues. Hence, they tend to receive low E scores, even if their carbon emissions are low. It also important to note that the number of firms assessed by Refinitiv has increased significantly over the years, and such increase is not uniform across industries. Despite the differences, there are upward trends in the ESG scores across the industry sectors.

We further summarise ESG trends of the tenants in our CoStar lease transactions, as shown in Figure 5. As the aggregation is based on much smaller samples, the large variations of ESG scores at the beginning of the time period are likely to be a result of an even smaller sample size[10]. Nevertheless, all three panels show similar upward trends in ESG scores among tenants, which further confirms the increasing recognition of ESG measures among the occupiers of London's commercial real estate market.

[10]*Fewer tenants' ESG could be matched to Refinitiv data.*

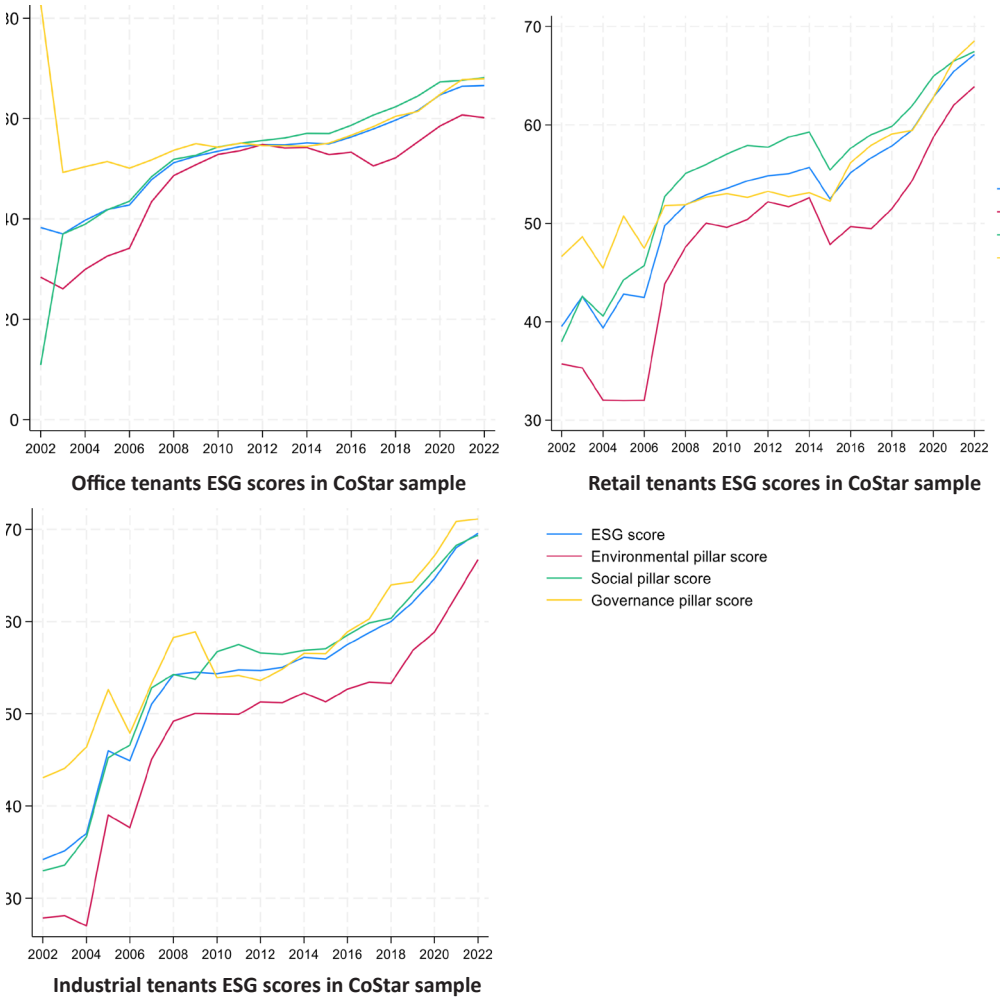

Figure 5. Tenants' ESG scores in CoStar lease transaction samples, by real estate sector

Chapter 6
Empirical methods

6.1 Choice of BREEAM-certified buildings

To understand a tenant's choice of locating in a sustainable building, we ran a series of probit models. We used the BREEAM label as an indication for sustainable spaces. In our baseline model in Equation (1), we included all building characteristics as explanatory variables, as buildings with certain physical attributes are likely to meet certain BREEAM criterion, and hence are more likely to be BREEAM certified:

(1) $$P\,(y_i = 1) = \Phi(\beta_0 + Phy_i\beta_1 + \varepsilon_i)$$

Where $y_i = 1$ if the building in which tenant i is located is BREEAM certified, 0 otherwise. $\Phi(\cdot)$ is the cumulative distribution function of the standard normal distribution. Phy_i is a vector of all physical attributes of the building, including building size, the number of stories, CoStar ratings, construction materials and the age of the building.

In Equation (2), we allow control at *submarket* and *sign year* levels to count for the potentially unobservable geographical and temporal variations respectively:

(2) $$P\,(y_i = 1) = \Phi(\beta_0 + Phy_i\beta_1 + Submarket_i\beta_2 + Year_i\beta_3 + \varepsilon_i)$$

In Equation (3), lease contract characteristics are included to explicitly examine if tenants' preference of BREEAM certified spaces is associated with the characteristics of the lease. For instance, tenants with longer lease contracts and those that need larger space may have stronger preference for BREEAM-labelled spaces due to the potential savings associated with higher-level energy efficiency.

(3) $$P\,(y_i = 1) = \Phi(\beta_0 + Phy_i\beta_1 + Submarket_i\beta_2 + Year_i\beta_3 + L_i\beta_4 + \varepsilon_i)$$

Where L_i is a vector of lease characteristics, including the total floor space leased, the floor level of the occupied space, lease term, repairing obligations, whether the lease is a new lease, and whether it is a head lease.

In the next step, we examine if the probability of selecting a BREEAM-certified building is associated with a tenant's characteristics. As discussed earlier, since listed firms are more likely to state a WTP for green building labels (Robinson, et al, 2016), it is possible that these firms are also more likely to locate in a green building. Motivated by this, we first included a dummy

variable to indicate whether the tenant is a listed company in Equation (4). We then subsequently included dummy variables that indicate tenants' industry sectors in Equation (5), as the probability of selecting a green-labelled building could also vary among industry sectors (Chegut, et al, 2014; Robinson, et al, 2016).

(4) $$P(y_i = 1) = \Phi(\beta_0 + X_i\beta_1 + Listed_i\beta_5 + \varepsilon_i)$$

(5) $$P(y_i = 1) = \Phi(\beta_0 + X_i\beta_1 + Listed_i\beta_5 + Industry_i\beta_6 + \varepsilon_i)$$

Where, for simplicity, X_i is a vector of all building attributes and lease characteristics. $Listed_i$ denotes whether the tenant of lease i is a publicly listed company and $Industry_i$ indicates the industry sector the tenant is in. Fixed effect at both submarket and sign year levels is also included in Equations (4) and (5).

Moving on to the ESG profiles of tenants, the overall Refinitiv ESG scores and separate E, S, G scores are included in the probit regressions, as shown in Equations (6) and (7) respectively, while allowing control for submarket, sign year and industry sectors. If tenants with higher ESG scores are more likely to select a BREEAM-certified building, coefficients β_7, β_8, β_9 or β_{10} would be significantly positive.

(6) $$P(y_i = 1) = \Phi(\beta_{0i} + X_i\beta_1 + ESG_i\beta_7 + \varepsilon_i)$$

(7) $$P(y_i = 1) = \Phi(\beta_0 + X_i\beta_1 + E\beta_8 + S_i\beta_9 + G_i\beta_{10} + \varepsilon_i)$$

6.2 Willingness to pay for BREEAM and tenants' ESG

In real estate research, hedonic modelling is the standard method for examining price/rent determinants. To isolate the effect of BREEAM labelling and tenant characteristics on rental prices, we also employ a set of hedonic regressions in this research.

There are a small number of unrealistically small and large values in the effective rent in our samples[12]. The outlier data points would potentially bias the regression results if included. Following Ling & Petrova (2008), Chinloy et al (2013), Nicholas & Scherbina (2013) and Robinson et al (2017), rather than deleting these observations, we implement a winsorizing process, where effect rents above the 99th percentile are replaced with the value of the 99th percentile and the same for below the first percentile.

We start with a baseline hedonic model, Equation (8), where it is assumed that the rental price of a commercial space can be broken down into its individual physical attributes, lease characteristics and locational measures:

(8) $$lnR_i = \alpha_0 + \alpha_1 Phy_i + \alpha_2 L_i + \alpha_3 Geocodes_i + \epsilon_i$$

Where lnR_i is the natural log of effective rent per square foot in a lease transaction. As in Equations (1) and (3) above, Phy_i and L_i are vectors of physical attributes and lease characteristics of lease *i*, respectively. These

[11] *We assume the extreme values are due to human errors when data was inputted or non-arms-length transactions.*

characteristics are expected to be significant determinants of rents. *Geocodes* consists of standardised spatial coordinators (longitudes and latitudes) and their cross products[12] to smooth the unobservable geographic differences of the properties (Dubin, 1992). We further include fixed effect at submarket and sign year levels to allow controls for locational and temporal effects. α_1, α_2 and α_3 are the respective vectors of parameters to be estimated. ϵ_i is a random error and stochastic disturbance term that is expected to take the form of a normal distribution.

As discussed in Section 3.1, sustainable related rent premiums are evident in empirical studies across different markets. To capture the effects of the sustainable label on rental prices, we use dummy variable $BREEAM_i$ to indicate whether a building has a BREEAM certification in Equation (9). A positive coefficient would indicate that, on average, BREEAM-certified buildings generate a rent premium.

(9) $$lnR_i = \alpha_0 + \alpha_1 \text{Phy}_i + \alpha_2 L_i + \alpha_3 geocodes_i + \alpha_4 BREEAM_i + \epsilon_i$$

One of the main objectives of this project is to investigate if there is a relationship between tenants' characteristics and their bargaining power in rent negotiation. We first include a dummy variable $Listed_i$, which indicates whether the tenant is a publicly listed company, in Equation (10), to see if listed tenants systematically pay different rents compared to private companies.

(10) $$lnR_i = \alpha_0 + \alpha_1 \text{Phy}_i + \alpha_2 \text{Li} + \alpha 3 Geocodes_i + \alpha_4 BREEAM_i + \alpha_5 Listed_i + \epsilon_i$$

Some industries may require prime locations, while others may be more flexible. Previous studies find that certain industries, such as law firms, consultancy and management, finance and real estate, pay significantly higher rents for product quality/status signalling (Nase, et al., 2019). Hence, we further allow control for tenant's industry sector: $Industry_i$ in Equation (11).

(11) $$lnR_i = \alpha_0 + \alpha_1 Phy_i + \alpha_2 L_i + \alpha_3 Geocodes_i + \alpha_4 BREEAM_i + \alpha_5 Listed_i + \alpha_6 Industry_i + \epsilon_i$$

It is possible that the WTP for BREEAM certified spaces differs among different types of tenants, as their demand for sustainable buildings differ. We include an interactive term $Listed_i \times BREEAM_i$ in Equation (12), where coefficient α_7 indicates the marginal WTP for BREEAM among listed companies, while allowing controls for submarket, sign year and industry sectors.

(12) $$lnR_i = \alpha_0 + \alpha_1 Phy_i + \alpha_2 L_i + \alpha_3 geocodes_i + \alpha_4 BREEAM_i + \alpha_5 Listed_i + \alpha_7 Listed_i \times BREEAM_i + \epsilon_i$$

Finally, focusing on tenants' ESG profiles, we include tenants' overall Refinitiv *ESG* scores and an interactive term, $ESG \times BREEAM$ in Equations (13) and (14). For simplicity, X_i denotes all physical (including BREEAM), locational and lease characteristics. While coefficient α_8 examines if more ESG-conscious firms

[12] *These are $x^2,\ldots,x^5$; $y^2,\ldots,y^5$; xy, $xy^2,\ldots$, xy^5, where x denotes latitude, and y denotes longitude.*

systematically pay a different level of rent for commercial spaces, coefficient α_9 estimates the marginal effect of ESG-focused firms on the WTP for BREEAM labels. The equations are estimated with fixed effects at submarket, sign year and industry levels. We then apply the same procedure but using the separate scores for E, S and G pillars in Equations (15) and (16).

(13) $$lnR_i = \alpha_0 + \alpha_1 X_i + \alpha_8 ESG_i + \epsilon_i$$

(14) $$lnR_i = \alpha_0 + \alpha_1 X_i + \alpha_8 ESG_i + \alpha_9 ESG_i \times BREEAM_i + \epsilon_i$$

(15) $$lnR_i = \alpha_0 + \alpha_1 X_i + \alpha_{10} E_i + \alpha_{11} S_i + \alpha_{12} G_i + \epsilon_i$$

(16) $$lnR_i = \alpha_0 + \alpha_1 X_i + \alpha_{10} E_i + \alpha_{11} S_i + \alpha_{12} G_i + \alpha_{13} E_i \times BREEAM_i + \alpha_{14} S_i \times BREEAM_i + \alpha_{15} G_i \times BREEAM_i + \epsilon_i$$

We apply Equations (1) to (16) to the office, retail and industrial samples separately.

6.3 Minimum energy efficiency performance requirement and Covid

As discussed in Section 2, from 1 April 2018 in England and Wales, regulation made it unlawful for landlords to grant new leases on commercial premises if the EPC rating was below E. The announcement regarding this minimum standard was made on 7 of December 2015 to allow time for stakeholders in the real estate markets to adjust. To evaluate the impact of such regulatory requirement, we generate a time dummy variable, *Regulation*, which takes the value of 1 if a lease was signed on or after the announcement date 7 December 2015[13].

Another consideration of this study is the Covid period. As highlighted in Section 3.3, it is possible that the demand for sustainable labelled buildings intensified during Covid due to the increased emphasis on health and wellbeing. The Covid period is defined as between 23 March 2020 (the first UK lockdown) and 19 July 2021 (when most legal limits on social contact were removed). To estimate the effect of this period, we generate a binary variable, *Covid* = 1, if a lease was signed during this period.

We include *Regulation* and *Covid*, along with a number of interactive terms, in our probit regression analysis as shown in Equations (17) - (24):

(17) $$P(y_i = 1) = \Phi(\beta_0 + X_i\beta_1 + Regulation\beta_{11} + \varepsilon_i)$$

(18) $$P(y_i = 1) = \Phi(\beta_0 + X_i\beta_1 + Regulation \times Listed_i\beta_{12} + \varepsilon_i)$$

(19) $$P(y_i = 1) = \Phi(\beta_0 + X_i\beta_1 + Regulation \times ESG_i\beta_{13} + \varepsilon_i)$$

(20) $$P(y_i = 1) = \Phi(\beta_0 + X_i\beta_1 + Regulation \times E_i\beta_{14} + Regulation \times S_i\beta_{15} + \text{Regulation} \times G_i\beta_{16} + \varepsilon_i)$$

(21) $$P(y_i = 1) = \Phi(\beta_0 + X_i\beta_1 + Covid\beta_{17} + \varepsilon_i)$$

(22) $$P(y_i = 1) = \Phi(\beta_0 + X_i\beta_1 + Covid \times Listed_i\beta_{18} + \varepsilon_i)$$

[13] *For a robustness check, we also examine whether 1st April 2018, when the regulation came into effect, has a significant impact on our regression estimates. The results are very similar to those obtained when using 7th December 2015.*

(23) $P(y_i = 1) = \Phi(\beta_0 + X_i\beta_1 + Covid \times ESG_i\beta_{19} + \varepsilon_i)$

(24) $P(y_i = 1) = \Phi(\beta_0 + X_i\beta_1 + Covid \times E_i\beta_{20} + Covid \times S_i\beta_{21} + Covid \times G_i\beta_{22} + \varepsilon_i)$

Where X_i is a vector of all variables that control for physical and locational attributes, lease and tenants' characteristics. In Equation (17), β_{11} is expected to be positive if the introduction of minimum EPC rating has intensified the demand for a BREEAM-certified building. In Equations (18), (19) and (20), *Regulation* is interacted with *Listed* and tenants' ESG scores to see if the regulation has a marginal effect on the probability of choosing a BREEAM-certified building among listed companies, and among firms with different ESG scores. By the same token, the effect of the Covid period is modelled similarly in Equations (21) - (24). As previously, we allow fixed effect at submarket, sign year and industry sector levels.

We then include similar measures in the hedonic model, as shown in Equations (25) - (32) below. In Equation (25), if the government's policy systematically changed the WTP for BREEAM-certified buildings, coefficient α_{16} is expected to be significantly different from 0. Coefficients α_{18}, α_{19}, α_{20}, α_{21} and α_{22} in Equations (26) - (28) measure the marginal effect of the EPC regulation on rental prices among listed tenants and ESG-driven tenants respectively. The marginal effects of the Covid periods are estimated by coefficients α_{24} - α_{29} in Equations (29) - (32).

(25) $lnR_i = \alpha_0 + \alpha_1 X_i + \alpha_4 BREEAM_i + \alpha_5 Listed_i + \alpha_{16} Regulation + \alpha_{17} Regulation \times BREEAMi + \epsilon_i$

(26) $lnR_i = \alpha_0 + \alpha_1 X_i + \alpha_4 BREEAM_i + \alpha_5 Listed_i + \alpha_{16} Regulation + \alpha_{18} Regulation \times Listed_i + \epsilon_i$

(27) $lnR_i = \alpha_0 + \alpha_1 X_i + \alpha_4 BREEAM_i + \alpha_8 ESG_i + \alpha_{16} Regulation + \alpha_{19} Regulation \times ESG_i + \epsilon_i$

(28) $lnR_i = \alpha_0 + \alpha_1 X_i + \alpha_4 BREEAM_i + \alpha_{10} E_i + \alpha_{11} S_i + \alpha_{12} G_i + \alpha_{17} Regulation + \alpha_{20} Regulation \times E_i + \alpha_{21} Regulation \times S_i + \alpha_{22} Regulation \times G_i + \epsilon_i$

(29) $lnR_i = \alpha_0 + \alpha_1 X_i + \alpha_4 BREEAM_i + \alpha_5 Listed_i + \alpha_{23} Covid + \alpha_{24} Covid \times BREEAM_i + \epsilon_i$

(30) $lnR_i = \alpha_0 + \alpha_1 X_i + \alpha_4 BREEAM_i + \alpha_5 Listed_i + \alpha_{23} Covid + \alpha_{25} Covid \times Listed_i + \epsilon_i$

(31) $lnR_i = \alpha_0 + \alpha_1 X_i + \alpha_4 BREEAM_i + \alpha_8 ESG_i + \alpha_{23} Covid + \alpha_{26} Covid \times ESG_i + \epsilon_i$

(32) $lnR_i = \alpha_0 + \alpha_1 X_i + \alpha_4 BREEAM_i + \alpha_{10} E_i + \alpha_{11} S_i + \alpha_{12} G_i + \alpha_{23} Covid + \alpha_{27} Covid \times E_i + \alpha_{28} Covid \times S_i + \alpha_{29} Covid \times G_i + \epsilon_i$

Again, we apply Equations (17) to (32) to the office, retail and industrial samples separately.

Chapter 7
Results

7.1 Choice of BREEAM-certified buildings

The results estimated by the probit regressions for the office sample are presented in Table 6. As expected, the probability of a building that is BREEAM certified is strongly associated with its physical attributes. As shown in column 1, taller and newer buildings, and those with higher CoStar ratings 4 and 5 and with lifts and parking spaces, are more likely to be BREEAM certified. Most of the coefficients remain consistent in terms of magnitudes when locational (at submarket level) and temporal (at sign year level) factors are considered in column 2.

Table 6: Estimated results of the Probit models, the office sample

	1		2		3		4		5		6		7	
	Eq (1)		Eq (2)		Eq (3)		Eq (4)		Eq (5)		Eq (6)		Eq (7)	
building_NIA	6.56E-09		2.86E-07	**	-1.32E-07		-1.85E-07		-2.00E-07		-4.59E-08		-1.62E-08	
building_storeys	0.012	***	0.010	***	0.019	***	0.020	***	0.020	***	-0.005		-0.004	
costar_1or2star	-0.368	*	-0.351	*	-0.327		-0.667	**	-0.919	**	(omitted)		(omitted)	
costar_3star	-0.081		-0.175	***	-0.207	***	-0.188	***	-0.176	***	-0.142		-0.062	
costar_4star	0.396	***	0.335	***	0.219	***	0.224	***	0.237	***	0.752	***	0.830	***
costar_5star	1.565	***	1.531	***	1.313	***	1.315	***	1.320	***	2.070	***	2.135	***
masonry	-0.537	***	-0.662	***	-0.640	***	-0.663	***	-0.674	***	4.516	***	4.400	***
metal	0.308		0.474		0.619		0.595		0.386		(omitted)		(omitted)	
r_concrete	-0.342	*	-0.483	***	-0.487	***	-0.523	***	-0.535	***	4.908	***	4.772	***
steel	-0.171		-0.171		-0.218		-0.233		-0.237		4.985	***	4.853	***
parking	3.30E-04	***	2.83E-04	**	3.99E-04	***	3.85E-04	***	3.74E-04	***	2.46E-03	***	2.56E-03	***
lifts	0.541	***	0.525	***	0.568	***	0.541	***	0.536	***	0.272		0.263	
age	-0.015	***	-0.017	***	-0.016	***	-0.016	***	-0.016	***	-0.021	***	-0.021	***
age_square	4.52E-05	***	5.33E-05	***	4.84E-05	***	4.89E-05	***	4.76E-05	***	1.07E-04	***	1.08E-04	***
size					5.40E-06	***	4.59E-06	***	4.46E-06	***	1.84E-06		1.69E-06	
size_square					-8.08E-12	**	-6.99E-12	**	-7.00E-12	**	-2.47E-12		-2.49E-12	
HighestFloor Occupied					-0.005		-0.004		-0.005		0.018		0.020	
term					0.007	***	0.007	***	0.007	***	0.015	***	0.014	***
term_square					-1.43E-05	***	-1.38E-05	***	-1.28E-05	***	-3.14E-05	***	-2.99E-05	**
FRI					0.012		0.022		0.036		-0.023		-0.038	
Break					-0.144	***	-0.151	***	-0.164	***	-0.155		-0.141	
newlease					0.243	***	0.253	***	0.255	***	0.245		0.242	
headlease					-0.048		-0.038		-0.024		0.192		0.189	
RentFreemonth					0.010	***	0.010	***	0.010	***	0.005		0.005	
Listed							0.204	***	0.205	***				
consumer discretionary									-0.244					

consumer staples									-0.182					
energy & utilities									-0.033					
financials									0.040					
healthcare									-0.244	*				
industrials									-0.021					
information technology									0.043					
non profit									-0.036					
real estate									-0.239	*				
ESG											0.001			
E													0.001	
S													0.001	
G													0.005	*
Constant	-1.168	***	-1.528	***	-2.919	***	-2.913	***	-2.877	***	-8.713	***	-8.931	***
Submarket	no		yes		yes		yes		yes		yes		yes	
Sign year	no		yes		yes		yes		yes		yes		yes	
tenant industry	no		no		no		no		yes		yes		yes	
Number of obs	18,368		18,367		18,138		17,189		16,077		927		926	
Pseudo R2	0.268		0.2789		0.3272		0.3267		0.3269		0.3689		0.374	
Log likelihood	-6186.32		-5874.74		-5632.411		-5452.37		-5194.22		-401.621		-398.0133	

Office sample. Dependent variable: BREEAM = 1 if certified, = 0 otherwise. A set of dummy variables on submarket, sign year and tenant industry sector are included in some/all regressions. Each column represents one separate regression. Estimated coefficients and their significance are reported.
*P < 0.1; **P < 0.05; ***P < 0.01.

In column 3, lease characteristics are included. Tenants that occupy larger floor areas and sign longer leases are more likely to occupy a BREEAM-certified building due to the potential significance in energy savings and lack of flexibility. Tenants are also more likely to choose a BREEAM-certified building if they are signing a new lease. With the option that the lease can be terminated earlier, tenants are less likely to choose a BREEAM building. Other features, such as the floor level, repairing and insuring obligations, and whether it is a head lease, are not significant determinants.

Moving on to tenants' characteristics, in line with findings from Robinson et al (2016), column 4 shows that the likelihood of choosing a BREEAM-certified building is around 3.7%[14] higher among publicly listed companies compared with private companies. This implies that the greater need for CSR disclosure is likely to motivate listed firms to locate in a sustainable building. This result is consistent when tenants' industry sectors are controlled for in column 5.

The significant coefficients associated with industry sectors are in line with discussions in the existing literature that the demand for sustainable buildings vary among industry sectors (Cajias, et al, 2014; Chegut, et al, 2014; Robinson, et al, 2016). Compared with the communication services sector (omitted category in the probit regression), firms in asset-driven sectors, such as real estate, and those with special purpose, such as healthcare, are less likely to choose a BREEAM building.

Regarding ESG measures, the estimates are based on a much smaller sample consisting only of tenants with Refinitiv ESG scores (referred to as the 'ESG only' subsample thereafter). Hence some of the variables with very few

[14] *The coefficients for probit models can be interpreted as the difference in Z score associated with each one-unit difference in the predictor variable. Based on the estimated coefficients in Table 6, the marginal effect of Listed company is calculated as 0.037.*

observations are omitted, and some coefficients and their significance have also changed in columns 6 and 7. Firms with higher ESG scores yield a positive but statistically insignificant coefficient, therefore we cannot conclude that firms with higher overall ESG scores are likely to choose a BREEAM-certified building. Nevertheless, when scores for the three pillars are examined separately in column 7, the G pillar score yields a significant positive coefficient at 10% level, suggesting that companies with an emphasis on internal governance structure and policies are more likely to choose a building with sustainable labels.

The results of the probit regressions for the retail and industrial samples[15] are presented in Table 7 and Table 8 respectively. In general, consistent with the office sample, larger, newer, and better-quality buildings are more likely to be BREEAM certified, and tenants are also more likely to select a BREEAM-certified building if they are signing a new lease.

Unlike in the office sample, industry sector differences are not present in the retail and industrial sectors. The probability of selecting a sustainable-labelled building also does not appear to be linked to whether a tenant is publicly listed. ESG scores yield insignificant coefficients in the retail sample, and due to the small number of observations, the coefficients of the ESG scores cannot be estimated in the industrial sample.

Table 7: Estimated results of the Probit models, the retail sample

	1		2		3		4		5		6		7	
	Eq (1)		Eq (2)		Eq (3)		Eq (4)		Eq (5)		Eq (6)		Eq (7)	
building_NIA	1.42E-06	***	1.36E-06	***	1.39E-06	***	1.34E-06	***	1.36E-06	***	3.25E-06	***	3.37E-06	***
building_storeys	0.010		0.001		2.97E-04	***	0.002		0.001	***	0.014		0.010	*
costar_3star	-1.560	***	-1.541	***	-1.524	***	-1.546	***	-1.621	***	-0.950	**	-0.906	**
costar_4star	-0.750	***	-0.767	***	-0.769	***	-0.785	***	-0.824	***	-0.443		-0.444	
masonry	-0.069		-0.316		-0.298		-0.362		-0.45618		-0.460		-0.447	
r_concrete	0.293		0.015		0.052		-0.022		-0.090		-0.011		0.022	
steel	0.350		0.133		0.161		0.079		0.018		0		0	
parking	-0.002	***	-0.002	***	-0.002	***	-0.002	***	-0.002	***	-0.002	***	-0.003	***
lifts	0.331	***	0.207	**	0.201	**	1.86E-01	***	0.178	*	0.442		0.486	
age	-0.009	***	-0.009	***	-0.009	***	-8.60E-03	***	-8.24E-03	***	-0.011		-0.013	*
age_square	2.31E-05	***	2.32E-05	***	2.20E-05	***	2.18E-05	***	2.10E-05	***	4.85E-05		5.58E-05	*
size					-5.79E-06	***	-5.93E-06		-8.71E-06		5.03E-05		7.08E-05	
size_square					1.39E-10	***	1.40E-10		1.65E-10		-4.61E-09	***	-5.42E-09	
HighestFloor Occupied					-0.040		-0.040		-3.68E-02		0.157		0.149	
term					3.09E-03		0.002		0.002		0.020	**	1.78E-02	*
term_square					-5.61E-06		-4.08E-06		-3.83E-06		-4.6E-05		-3.8E-05	
FRI					0.059		0.069		0.061		0.107		0.116	
Break					-0.140	**	-0.146	**	-0.133	*	-0.242		-0.169	
newlease					0.173		0.169		0.177		-0.138		-0.125	
headlease					0.170		0.172		0.131		1.128	**	1.074	**
RentFreemonth					0.024	***	0.023	***	0.024	***	0.028		0.026	
Listed							-0.009		-0.060					

[15]*Same variables are not present or omitted due to very small number of observations in these samples, for example in the retail sample, the estimates of CoStar 3-4 ratings are compared to CoStar_5star rating. Energy & Utility and non-profit sectors are not present in the sample.*

consumer discretionary							0.05648					
consumer staples							-0.13921					
financials							0.234					
health care							-0.181					
industrials							-0.214					
information technology							-0.343					
real estate							0.068					
ESG									-0.001			
E											0.011	
S											-0.011	
G											-0.006	
Constant	-0.447		0.432		-0.402		-0.243		0.029	***	-3.513	**	-2.975	**
Submarket	no		yes		yes		yes		yes		yes		yes	
Sign year	no		yes		yes		yes		yes		yes		yes	
tenant industry	no		no		no		no		yes		yes		yes	
Number of obs	4,971		4,964		4,901		4,674		4,474		355		355	
Pseudo R2	0.365		0.4191		0.4364		0.431		0.4371		0.4749		0.4817	
Log likelihood	-883.549		-807.876		-775.339		-763.553		-734.734		-71.8752		-70.9523	

Retail sample. Dependent variable: BREEAM = 1 if certified, = 0 otherwise. A set of dummy variables on submarket, sign year and tenant industry sector are included in some/all regressions. Each column represents one separate regression. Estimated coefficients and their significance are reported.
*P < 0.1; **P < 0.05; ***P < 0.01.

Table 8: Estimated results of the Probit models, the industrial sample

	1		2		3		4		5	
	Eq (1)		Eq (2)		Eq (3)		Eq (4)		Eq (5)	
building_NIA	-4.92E-06	***	-6.07E-06	**	-1.1E-05	***	0.000	***	-1.1E-05	***
building_stories	0.256	***	0.411	***	0.448	***	0.393	**	0.363266	**
costar_3star	-0.348	*	-0.088		0.012		0.002		-0.052	
metal	4.815	***	4.646	***	4.691	***	4.306	***	4.342	***
steel	4.367	***	4.523	***	4.809	***	4.728	***	4.858	***
parking	0.006	***	0.013	***	0.015	***	0.016	***	0.015	***
lifts	-0.364		0.146		0.111		-2.59E-01		-0.371	
age	-0.134	***	-0.155	***	-0.170	***	-0.181	***	-0.180	***
age_square	0.002	***	0.002	***	0.002	***	0.003	***	0.003	***
size					1.96E-05		2.00E-05		2.66E-05	*
size_square					-1.33E-10		-1.18E-10		-1.76E-10	
HighestFloorOccupied					0.248		0.277		0.306	
term					0.005		0.010		0.008	
term_square					-1.6E-05		-3.13E-05		-2.8E-05	
FRI					-0.387	**	-0.417	**	-0.393	*
Break					0.162		0.103		0.141	
newlease					1.012	**	1.009	**	(omitted)	
RentFreemonth					0.021	**	0.020	*	0.020	*
Listed							-0.045		-0.037	
consumer discretionary									-0.419	
consumer staples									-0.564	
industrials									-0.437	
information technology									0.036	
Constant	-5.006	***	-6.505	***	-8.761	***	-8.380	***	-6.740	***

Submarket	no	yes	yes	yes	yes
Sign year	no	yes	yes	yes	yes
tenant industry	no	no	no	no	yes
Number of obs	1,770	1,736	1,515	1,451	1,132
Pseudo R2	0.334	0.3934	0.4509	0.4791	0.4659
Log likelihood	-196.278	-177.942	-150.679	-135.041	-123.76

Industrial sample. Dependent variable: BREEAM = 1 if certified, = 0 otherwise. A set of dummy variables on submarket, sign year and tenant industry sector are included in some/all regressions. Each column represents one separate regression. Estimated coefficients and their significance are reported. *P < 0.1; **P < 0.05; ***P < 0.01.

7.2 Rent, WTP for BREEAM and ESG

Hedonic regression results with the office sample are presented in Table 9. The models explain around 59% of the variation in rents in the full sample (which is similar to the adjusted R^2 in Chegut et al (2014), who also use office data in London), and around 57% in the 'ESG only' subsample.

Table 9: Hedonic regression estimates, the office sample

	1		2		3		4		5		6		7		8		9	
	Eq (8)		Eq (9)		Eq (10)		Eq (11)		Eq (12)		Eq (13)		Eq (14)		Eq (15)		Eq (16)	
building_NIA	2.85E-09		9.43E-09		-6.01E-09		-2.58E-08		-2.75E-08		-2.09E-07	**	-2.02E-07	**	-2.08E-07	**	-2.00E-07	**
building_storeys	-0.004	***	-0.005	***	-0.005	***	-0.004	***	-0.004	***	0.004	**	0.004	**	0.005	**	0.004	**
costar_1or2star	0.078	***	0.075	***	0.073	***	0.075	***	0.075	***	0.450	**	0.455	**	0.443	**	0.453	**
costar_3star	0.034	***	0.034	***	0.037	***	0.039	***	0.040	***	-0.017		-0.014		-0.016		-0.011	
costar_4star	0.100	***	0.094	***	0.097	***	0.096	***	0.096	***	0.108	***	0.099	**	0.106	**	0.100	**
costar_5star	0.250	***	0.210	***	0.208	***	0.202	***	0.204	***	0.136	***	0.122	**	0.131	**	0.120	**
parking	9.45E-05	***	8.52E-05	***	9.27E-05	***	1.01E-04	***	1.02E-04	***	3.57E-04	***	3.61E-04	***	3.62E-04	***	3.63E-04	***
lifts	0.024	***	0.020	***	0.020	***	0.024	***	0.024	***	0.115	***	0.134	***	0.117	***	1.34E-01	***
age	-0.001	***	-0.001	***	-0.001	***	-0.001	***	-0.001	***	-0.002	**	-0.003	**	-0.002	**	-2.45E-03	**
age_square	5.31E-06	***	4.74E-06	***	4.99E-06	***	4.75E-06	***	4.73E-06	***	1.27E-05	**	1.35E-05	**	1.30E-05	***	1.32E-05	**
size	8.41E-07	***	6.54E-07	***	4.98E-07	**	4.27E-07	*	4.58E-07	**	7.14E-07		7.17E-07		6.64E-07		7.15E-07	
size_square	-7.37E-13	**	-5.38E-13	*	-4.14E-13		-3.85E-13		-4.14E-13		-5.87E-13		-5.71E-13		-5.49E-13		-5.76E-13	
lease_totalNIA	-0.189	***	-0.179	***	-0.168	***	-0.165	***	-0.166	***	-0.099		-0.095		-0.091		-0.092	
HighestFloor Occupied	0.016	***	0.016	***	0.016	***	0.014	***	0.014	***	0.009	***	0.009	***	0.009	***	0.009	***
term	0.003	***	0.003	***	0.003	***	0.003	***	0.003	***	0.001	*	0.001	*	0.001	**	0.001	
term_square	-6.90E-06	***	-6.64E-06	***	-6.42E-06	***	-6.11E-06	***	-6.12E-06	***	-2.96E-06		-2.61E-06		-2.83E-06		-2.57E-06	
FRI	-0.004		-0.004		-0.003		-0.003		-0.003		0.014		0.014		0.014		0.014	
Break	-0.019	***	-0.016	**	-0.014	***	-0.016	***	-0.016	***	0.002		0.002		0.001		0.001	
newlease	0.041	***	0.035	***	0.036	***	0.037	***	0.038	***	0.054		0.051		0.056		0.051	
headlease	0.008		0.009		0.008		0.011		0.012		0.024		0.025		0.024		0.024	
RentFreemonth	-0.005	***	-0.005	***	-0.005	***	-0.005	***	-0.005	***	-0.007	***	-0.007	***	-0.007	***	-0.007	***
BREEAM			0.091	***	0.093	***	0.087	***	0.093	***	0.037		0.036		0.127	*	0.063	
Listed					0.034	***	0.027	***	0.042	***								
consumer discretionary							0.047	*										
consumer staples							0.097	***										
energy & utilities							0.193	***										
financials							0.201	***										

healthcare							0.011													
industrials							0.116	***												
information technology							0.125	***												
non profit							0.073	**												
real estate							0.120	***												
BREEAM*Listed									-0.044	**										
ESG											-2.01E-04				0.001					
BREEAM*ESG															-0.002					
E													-0.001				-0.001			
S													0.001				0.001			
G													-2.13E-04				-1.62E-04			
BREEAM*E																	-0.001			
BREEAM*S																	2.31E-04			
BREEAM*G																	-1.27E-04			
Constant	3.249	***	3.268	***	3.227	***	3.107	***	3.102	***	3.380	***	3.398	***	3.335	***	3.392	***		
Geocodes	yes		yes		yes		yes		yes		yes		yes		yes		yes			
Construction materials	yes		yes		yes		yes		yes		yes		yes		yes		yes			
Submarket	yes		yes		yes		yes		yes		yes		yes		yes		yes			
Sign year	yes		yes		yes		yes		yes		yes		yes		yes		yes			
tenant industry	no		no		no		yes		yes		yes		yes		yes		yes			
Number of obs	18,083		18,083		17,136		16,030		16,030		967		943		967		943			
Adjust R squared	0.5823		0.5851		0.5852		16030		16030		0.5707		0.5722		0.5712		0.5709			
F statistics	250.58	***	251.02	***	235.68	***	208.78	***	207.02	***	13	***	12.56	***	12.91	***	12.19	***		

Office sample. Dependent variable: natural log of effective rent/ sq ft p.a. The Table reports estimated coefficients. *P < 0.1; **P < 0.05; ***P < 0.01.

Consistent with findings in the previous hedonic studies in Table 1, the baseline model in Column (1) shows that most building and lease characteristic variables yield significant coefficients. For instance, higher rents are associated with spaces with better quality indicators (such as age, higher CoStar ratings, parking, lifts), *ceteris paribus*. The larger a leased space is relative to the whole building, the lower the rent, due to quantum discount. Tenants pay a rent premium associated with views for higher floor levels. The lease term is positively but non-linearly related to rental level. On average, rents are lower in leases with break clauses, and tenants pay higher rent for new leases compared to renewals[16].

The coefficients estimated in the baseline model remain consistent when BREEAM is added to the equation, as shown in column 2. BREEAM-certified office buildings appear to generate a rent premium of 8.7%-9.3%, which is higher than the premium found in Chegut et al (2014), but lower than findings from Fuerst & van de Wetering (2015).

Contrary to conjecture that more established publicly traded companies may have more negotiating power and may secure lower rent, the estimations in column 3 show that, on average, listed companies pay approximately 3% more in rent compared with private companies. A possible explanation for this small rent premium is that companies with stronger financial stability (i.e. listed firms) may pay higher premiums to secure more prestigious buildings or locations (Tay, et al., 1999). Again, the estimated results remain consistent

[16]*This is different from Fisher & Lentz (1990), which shows that existing tenants tend to pay more than new tenants.*

with the inclusion of industry sectors (see column 4). In line with findings in Nase, et al (2019), our results also show significant differences in rent paid by firms in different industry sectors.

Notably, although the rent associated with BREEAM is still evident, the interactive term $Listed_i \times BREEAM_i$ in column 5 is significantly negative, which suggests that listed tenants have marginally lower WTP for BREEAM labels. This could be a result of increased supply that is specific to listed firms, as discussed in Chegut et al (2014), the marginal WTP for sustainable buildings decreases as the supply increases. It could also be that listed companies tend to be larger, and savings from energy efficiency might be relatively low compared to their overall operational costs (Fuerst & McAllister, 2011c), hence the sustainable features of buildings might not be a significant consideration for listed firms.

The final four columns show the results of hedonic regressions with ESG scores and their interactive terms in the 'ESG only' subsample. Column 6 shows that the coefficient associated with the overall ESG scores is negative: however, it is not statistically significant, hence our results do not directly support the hypothesis that ESG-driven companies have stronger bargaining power in the rent negotiation.

The interactive term $ESG_i \times BREEAM_i$ in column 8 yields an insignificant coefficient. This suggests that there are no differences in the marginal WTP for BREEAM among firms with different ESG scores. The examination of separate scores for the three pillars and their interactive terms with BREEAM also show insignificant coefficients (columns 7 and 9). Hence, office rental prices do not appear to exhibit differences among firms with different ESG agendas.

A limitation with our retail and industrial samples is the relatively low explanatory power of the hedonic models at 32%-37%, implying that there are other rent determinants that are not observable/or cannot be quantified in our dataset. In the retail full samples (Table 10), the estimates of physical and lease attributes are generally consistent with expectations. Notably, older buildings appear to have rent premiums, reflecting the potential better performance of older retail properties at well-established locations (such as the central London). BREEAM however, is not found to be associated with a rental premium.

Listed tenants in the retail sector also appear to pay higher rent (columns 3-5). However, unlike in the office sample, the marginal WTP for BREEAM is higher among listed tenants (column 5). While the overall ESG scores of retail tenants do not seem to affect the rental price they pay, tenants with stronger governance structures/policies pay less rent. This rental discount could be related to anchor tenants, which are likely to have higher governance measures. The interactive terms between BREEAM and ESG do not yield significant coefficients in the retail sample.

Table 10: Hedonic regression estimates, the retail sample

	1		2		3		4		5		6		7		8		9	
	Eq (8)		Eq (9)		Eq (10)		Eq (11)		Eq (12)		Eq (13)		Eq (14)		Eq (15)		Eq (16)	
building_NIA	3.78E-07	***	3.70E-07	***	3.75E-07	***	3.47E-07	***	3.46E-07	***	2.51E-07		2.34E-07		2.58E-07		2.58E-07	
building_storeys	-0.007	**	-0.007	**	-0.006	*	-0.003		-0.003		0.007		6.08E-03		0.007		0.005313	
costar_1star	-0.425		-0.444	***	-0.446	***	-0.410		-0.413		(omitted)		(omitted)		(omitted)		(omitted)	
costar_2star	-0.243	***	-0.263	***	-0.255	***	-0.249	***	-0.250	***	-0.671	**	-6.98E-01	**	-0.656	**	-0.68316	**
costar_3star	-0.126	*	-0.146	**	-0.129	*	-0.117		-0.118		-0.430	*	-4.34E-01	*	-0.416	*	-0.41659	*
costar_4star	0.095	***	0.080		0.079	***	0.082	***	0.082		-0.183		-1.96E-01		-0.171		-0.17938	
parking	9.40E-05	***	9.20E-05	***	8.23E-05	***	9.13E-05	***	0.000	***	4.13E-05		3.85E-05		4.16E-05		3.38E-05	
lifts	-0.027		-2.59E-02	***	-0.03632		-0.043		-0.044		-0.026		-0.028		-0.029		-0.03193	
age	0.001	**	0.001	*	0.001	*	0.001	***	0.001		0.006	***	0.006		0.006	***	0.006147	**
age_square	6.14E-07		7.61E-07		6.61E-07		1.24E-06		1.26E-06		-1.7E-05		-1.6E-05		-1.7E-05		-1.7E-05	
size	-6.73E-05	***	-6.74E-05	***	-7.1E-05	***	-6.7E-05	***	-6.7E-05	***	-5.3E-05	***	-5.4E-05	***	-5.2E-05	***	-5.3E-05	***
size_square	7.12E-10	***	7.14E-10	***	7.39E-10	***	6.95E-10	***	6.96E-10	***	4.76E-10	***	4.85E-10	***	4.70E-10	***	4.79E-10	***
lease_totalNIA	-0.259	***	-0.259	***	-0.24649	***	-0.237	***	-0.239	***	-0.503	**	-0.513	**	-0.510	**	-0.51406	**
HighestFloor Occupied	0.031	***	0.031	***	0.031	***	0.020		0.020	*	0.025		0.027		0.023		0.025762	
term	0.001		0.001	***	0.000		0.001		0.001		-0.002		-0.003		-0.003		-0.00316	
term_square	-3.13E-06		-3.16E-06		-1.63E-06		-2.02E-06	***	-2.00E-06		1.05E-05		1.12E-05		0.000		1.25E-05	
FRI	0.011		0.010		0.014		0.004	***	0.004		-0.051		-0.061		-0.054		-0.07107	
Break	-0.074	***	-0.076	***	-0.087	***	-0.081	***	-0.081	***	-0.197	***	-0.216	***	-0.193	**	-0.20961	***
newlease	0.009		0.010		0.031		0.031		0.031		0.026		0.047		0.027		0.047898	
headlease	0.021		0.021		0.041		0.048		0.046		-0.141		-0.152		-0.137		-0.15151	
RentFreemonth	-0.005	***	-0.005	***	-0.004	**	-0.003	*	-0.003	*	-0.001		0.000		-0.001		-0.00034	
BREEAM			-0.063		-0.023		-0.012		-0.042		0.063		0.063		-0.289		-0.14584	
Listed					0.225	***	0.182	***	0.168	***								
consumer discretionary							0.346											
consumer staples							0.345											
energy & utilities							1.981											
financials							0.417											
health care							0.078											
industrials							0.228											
information technology							0.460											
non profit							-0.390											
real estate							0.213											
BREEAM*Listed									0.181	*								
ESG															-0.001			
BREEAM*ESG											-0.001				0.007			
E													-0.001				-0.001	
S													0.005				0.005	*
G													-0.004		*		-0.004	**
BREEAM*E																	0.007	
BREEAM*S																	-0.010	
BREEAM*G																	0.007	
Constant	4.142	***	4.169	***	4.044	***	3.709	***	3.720	***	4.067	***	4.222	***	4.059	***	4.221	***
Geocodes	yes		yes		yes		yes		yes		yes		yes		yes		yes	
Construction materials	yes		yes		yes		yes		yes		yes		yes		yes		yes	

Submarket	yes		yes		yes		yes		yes		yes		yes		yes		yes		yes	
Sign year	yes		yes		yes		yes		yes		yes		yes		yes		yes		yes	
tenant industry	no		no		no		yes		yes		yes		yes		yes		yes		yes	
Number of obs	5,950		5,950		5,571		5,307		5,307		603		603		603		603		603	
Adjust R squared	0.3198		0.3199		0.3292		0.3366		0.3368		0.3697		0.3730		0.3693		0.3715			
F statistics	30.45	***	30.15	***	29.18	***	26.64	***	26.43	***	4.8	***	4.77	***	4.75	***	4.63	***		

Retail sample. Dependent variable: natural log of effective rent/ sq ft p.a. The Table reports estimated coefficients. *P < 0.1; **P < 0.05; ***P < 0.01.

In the industrial sample (Table 11), while the physical and lease attributes are generally in line with expectations, BREEAM related rental premium is also not evident. Furthermore, tenants' characteristics do not appear to be associated with the level of rent they pay.

Table 11: Hedonic regression estimates, the industrial sample

	1		2		3		4		5		6		7		8		9	
	Eq (8)		Eq (9)		Eq (10)		Eq (11)		Eq (12)		Eq (13)		Eq (14)		Eq (15)		Eq (16)	
building_NIA	5.68E-07	**	5.68E-07	**	7.07E-07	***	7.25E-07	***	7.26E-07	***	-2.09E-06	**	-1.70E-06	*	-2.09E-06	**	-1.67E-06	*
building_storeys	-5.47E-03		-0.005		-0.009		-0.011		-0.011		0.020		0.014		0.020		0.010	
costar_1star	-0.042		-0.042		-0.064		-0.041		-0.041		0.434		0.430		0.421		0.483	
costar_2star	-1.40E-01	***	-0.139	***	-0.142	**	-0.139	**	-0.139	**	-0.249	*	-0.257	*	-0.250	*	-0.279	*
costar_3star	-0.206	***	-0.206	***	-0.205		-0.199	***	-0.199	***	-0.238	*	-0.244	*	-0.238	*	-0.265	**
costar_4star	0.000		0		0		0		0		0		0		0		0	
parking	0.000583	*	0.001	*	0.001	*	0.001	*	6.15E-04	*	0.002	*	0.002		0.002	*	0.002	
lifts	3.03E-03		0.003		-0.008		-0.003		-0.003		-0.092		-0.153		-0.093		-0.154	
age	-0.00675	***	-0.00675	***	-0.007	***	-0.006	***	-0.006	***	-0.005		-0.005		-0.005		-0.005	
age_square	3.99E-05	***	3.99E-05	***	3.99E-05	***	3.55E-05	***	3.56E-05	***	3.22E-05		2.66E-05		3.35E-05		1.82E-05	
size	-1.00E-05	***	-1.00E-05	***	-1E-05	***	-1E-05	***	-1E-05	***	-9.08E-06	**	-1E-05	**	-9.10E-06	**	-1.1E-05	**
size_square	3.32E-11	***	3.32E-11	***	3.27E-11	***	3.14E-11	***	3.14E-11	***	3.35E-11	**	3.57E-11	***	3.36E-11	**	3.63E-11	***
lease_totalNIA	-0.07791		-0.078		-0.046		-0.045		-4.54E-02		0.005		0.057		0.006		0.063	
HighestFloor Occupied	-0.00565		-0.006		-2.50E-03		-0.001		-0.001		-0.039		-0.037		-0.040		-0.040	
term	0.002	***	0.002	***	0.002	***	0.002	***	0.002	***	-4.61E-04		-0.001		0.000		-0.001	
term_square	0.000	**	-5.51E-06	**	-6.12E-06	***	-6.83E-06	***	-6.82E-06	***	5.19E-06		8.54E-06		5.18E-06		9.39E-06	
FRI	0.032	*	0.032	*	0.039	**	0.042	**	0.042	**	0.067		0.067		0.068		0.067	
Break	-0.028	*	-0.028	*	-0.028	*	-0.029	*	-0.029	*	-0.136	***	-0.151	***	-0.138	***	-0.152	***
newlease	-0.011		-0.011		-0.014		-0.010		-0.010		0.070		0.065		0.070		0.063	
headlease	0.058		0.058		0.071		0.067		0.067		-0.119		-0.047		-0.117		-0.030	
RentFreemonth	-0.001		-0.001		-0.001		-0.001		-0.001		-0.009	**	-0.009	**	-0.009	**	-0.009	**
BREEAM			0.002		0.009		0.013		0.017		0.100		0.124		0.175		0.425	
Listed					0.031		0.037		0.039									
consumer discretionary							0.161											
consumer staples							-0.059											
energy & utilities							0.020											
financials							0.031											
healthcare							-0.084											
industrials							-0.028											
information technology							-0.022											

non profit							-0.030													
real estate							-0.194	**												
BREEAM*Listed									-0.031											
ESG											0.001				0.001					
BREEAM*ESG															-0.001					
E													-0.001				-0.002			
S													0.004		**		0.004			
G													-0.002				-0.002			
BREEAM*E																	0.005			
BREEAM*S																	-0.009			
BREEAM*G																	-0.002			
Constant	4.142	***	4.169	***	4.044	***	3.273	***	3.273	***	3.970	***	3.904	***	3.966	***	3.941	***		
Geocodes	yes		yes		yes		yes		yes		yes		yes		yes		yes			
Construction materials	yes		yes		yes		yes		yes		yes		yes		yes		yes			
Submarket	yes		yes		yes		yes		yes		yes		yes		yes		yes			
Sign year	yes		yes		yes		yes		yes		yes		yes		yes		yes			
tenant industry	no		no		no		yes		yes		yes		yes		yes		yes			
Number of obs	2,514		2,514		2,329		2,196		2,196		190		190		190		190			
Adjust R squared	0.3520		0.3518		0.3513		0.3420		0.3417		0.5682		0.5817		0.5647		0.5733			
F statistics	20.50***	***	20.21	***	18.76	***	15.26	***	15.07	***	4.55	***	4.65	***	4.45	***	4.39	***		

Industrial sample. Dependent variable: natural log of effective rent/ sq ft p.a. The Table reports estimated coefficients. *P < 0.1; **P < 0.05; ***P < 0.01.

7.3 The impact of government regulation on minimum EPC and Covid

The results of the probit regressions with the consideration of regulation and Covid are presented in Table 12 and Table 13. Locational, physical and lease attributes are included in the regressions – for presentation purposes, their results are omitted from the table.

Examining the office sample first (Table 12), consistent with the previous results, listed companies remain more likely to select a BREEAM-certified space with the introduction of regulation and the consideration of the Covid period. The effect of the government announcement regarding minimum EPC ratings and the Covid period on listed firms remains unchanged, indicated by the insignificant coefficients yielded by the interactive terms *Regulation* × *Listed* and *Covid* × *Listed*.

The minimum EPC rating is expected to increase the supply of energy efficient buildings, which is partially evident in the 'ESG only' subsample (columns 3 and 4), where the probability of an office space being BREEAM certified has significantly increased since the announcement. There is also evidence that the probability of a tenant selecting a BREEAM-certified space increased during the Covid period (column 6), in line with the increased emphasis on health and wellbeing during the pandemic.

Overall, our results suggest that in the office sector, the preference for sustainable buildings has not changed among ESG-driven firms as a result of regulation or during the pandemic period.

Table 12: Probit regressions estimates with regulation announcement and Covid period considerations, the office sample

	1 Eq (17)		2 Eq (18)		3 Eq (19)		4 Eq (20)		5 Eq (21)		6 Eq (22)		7 Eq (23)		8 Eq (24)	
Listed	0.205	***	0.195	***					0.205	***	0.198	***				
ESG					-0.008								0.001			
E							-0.001								4.35E-04	
S							0.005								0.001	
G							0.005								0.005	**
Regulation	-0.077		-0.081		1.276	***	1.161	**								
Regulation* Listed			0.023													
Regulation*ESG					-0.008											
Regulation*E							0.002									
Regulation*S							-0.007									
Regulation*G							0.000									
Covid									0.237	*	0.211		0.776		1.263	
Covid*Listed											0.276					
Covid*ESG													-0.005			
Covid*E															0.033	
Covid*S															-0.029	
Covid*G															-0.009	
Constant	-2.876	***	-2.874	***	-8.378	***	-8.890	***	-2.894	***	-2.891	***	-8.412	***	-8.786	***
Number of obs	16,075		16,075		950		926		16,075		16,075		950		926	
Pseudo R2	0.327		0.3269		0.371		0.38		0.327		0.327		0.362		0.3765	
Log likelihood	-5194		-5194		-410		-394		-5192		-5192		-415		-396	

Office sample. Dependent variable: BREEAM = 1 if certified = 0 otherwise. A set of variables on physical attributes, geocodes, lease attributes, submarket, sign year and tenant industry sector are included in all regressions. Each column represents one separate regression. Estimated coefficients and their significance are reported. *P < 0.1; **P < 0.05; ***P < 0.01

The results from the retail and industrial sectors are shown in Table 13. Due to the small number of observations, the coefficients of the interactive terms between regulation/Covid and ESG cannot be estimated. Our results show that the probability of a space being BREEAM certified has not changed since the government's announcement or during Covid. However, we find some evidence that listed tenants in the retail sector appear to be more likely to select BREEAM certified space during Covid (column 6).

Table 13: Probit regressions estimates with regulation announcement and Covid period considerations, the retail and industrial samples

	Retail sample								Industrial sample							
	1 Eq (17)		2 Eq (18)		5 Eq (21)		6 Eq (22)		1 Eq (17)		2 Eq (18)		5 Eq (21)		6 Eq (22)	
Listed	-0.062	-0.215	-0.060	-0.090					-0.041		-0.441		-0.051		-0.003	
ESG																
E							-0.001									
S							0.005									
G							0.005									
Regulation	-0.147	-0.188				***	1.161	**	0.047		-0.010					

Regulation* Listed	0.198										0.495					
Regulation*ESG					-0.008											
Regulation*E							0.002									
Regulation*S							-0.007									
Regulation*G							0.000									
Covid			0.001	-0.260									0.697		0.863	
Covid*Listed				1.386	***											
Constant	0.074	0.118	0.029	0.079					-9.609	***	-6.661	***	-6.720	***	-6.702	***
Number of obs	4,474		4,474		4,474		4,474		1,132		1,132		1,132		1,128	
Pseudo R2	0.4376		0.4379		0.4371		0.439		0.466		0.4671		0.47		0.472	
Log likelihood	-734		-734		-735		-733		-124		-123		-123		-122	

Retail and Industrial samples. Dependent variable: BREEAM = 1 if certified = 0 otherwise. A set of variables on physical attributes, geocodes, lease attributes, submarket, sign year and tenant industry sector are included in all regressions. Each column represents one separate regression. Estimated coefficients and their significance are reported. *P < 0.1; **P < 0.05; ***P < 0.01. ESG scores and interactive terms cannot be estimated due to small number of observations.

The results of the hedonic regressions with the consideration of regulation and the Covid period are shown in Table 14, Table 15 and Table 16 for the office, retail and industrial samples respectively. Regarding the office sample, the estimated coefficients remain similar to those in Table 9. Rent has increased by 10% on average in the full sample since the regulation announcement date, reflecting the overall upward trend in office rent in London since late 2015.

The WTP for BREEAM-certified buildings has not changed since the government announcement, indicated by the insignificant coefficient of the interactive term *Regulation* × *BREEAM* in column 1. However, the interactive term *Regulation* × *Listed*$_i$ yields a significantly negative coefficient. The reduced rent premiums by listed firms after the announcement could be a result of increased supply of more energy-efficient spaces since the government's announcement on the minimum EPC requirement.

With the 'ESG only' office subsample, consistent with results in Table 9, the overall ESG score remains an insignificant determinant of rent. Its interactive term with regulation is also insignificant. However, the examination of separate scores for the three pillars show that firms with a strong emphasis on the 'social' aspect tend to pay more for office rent, but such social-related rent premium has been diminished since the government's announcement.

As expected, office rents decreased during the Covid period (column 5). Rent premium associated with BREEAM is strongly evident during the Covid period. This could be a result of increased emphasis on health and wellbeing during the pandemic. It is also partially in line with the argument from Eichholtz et al (2013) that the market places a premium on operational cost savings in a more efficient building even during a period of economic decline.

The negative coefficient of *Covid* × *Listed* is marginally significant, suggesting that listed firms' bargaining power could have increased during the pandemic.

The overall ESG scores remain insignificant in the hedonic model for offices

with the consideration of Covid. The final column shows that firms with higher E scores paid lower rent during Covid, but office tenants with strong emphasis on the social factors paid a rental premium. Such results should be interpretated with caution, however, as the estimates are based on a small sample of observations over a relatively long period of time.

Table 14: Hedonic regression estimates with the consideration of regulation and Covid, the office sample

	1		2		3		4		5		6		7		8	
	Eq (25)		Eq (26)		Eq (27)		Eq (28)		Eq (29)		Eq (30)		Eq (31)		Eq (32)	
Listed	0.027	***	0.049	***					0.027	***	0.029	***	0.041		0.044	
BREEAM	0.097	***	0.087	***	0.032		0.031		0.084	***	0.087	***				
ESG					0.001								-2.34E-04			
E							-0.001								-0.001	
S							0.002	***							0.001	
G							-0.001								0.000	
Regulation	0.099	***	0.100	***	0.213	**	0.216	**								
Regulation* BREEAM	-0.022															
Regulation* Listed			-0.055	***												
Regulation*ESG					-0.002											
Regulation*E							0.000									
Regulation*S							-0.003	**								
Regulation*G							0.001									
Covid									-0.052	**	-0.026		-0.419	*	-0.859	***
Covid*BREEAM									0.110	***						
Covid*Listed											-0.097	*				
Covid*ESG													0.003			
Covid*E															-0.009	**
Covid*S															0.011	*
Covid*G															0.005	
Constant	3.106	***	3.103	***	3.338	***	3.391	***	3.106	***	3.110	***	3.389	***	3.450	***
Number of obs	16,030		16,030		967		943		16,030		16,030		967		943	
Pseudo R2	0.5926		0.5927		0.572		0.5748		0.5923		0.5922		0.5726		0.5767	
Log likelihood	205.50***		205.62***		12.83***		12.27***		205.29***		205.19***		12.87***		12.36***	

Office sample. Dependent variable: natural log of effective rent/ sq ft p.a. A set of variables on physical attributes, geocodes, lease attributes, submarket, sign year and tenant industry sector are included in all regressions. Each column represents one separate regression. Estimated coefficients and their significance are reported. *P < 0.1; **P < 0.05; ***P < 0.01

Results from the retail sample in Table 15 are consistent with those in Table 10, on average: listed firms pay higher rent for retail properties in London. The coefficients related to regulation, Covid and ESG are not statistically significant. Contrary to Wen et al (2022), results in the industrial sample in Table 16 also show rent decline during Covid. As above, the coefficients associated with ESG scores should be interpretated with caution due to the small sample size.

Table 15: Hedonic regression estimates with the consideration of regulation and Covid, the retail sample

	1		2		3		4		5		6		7		8	
	Eq (25)		Eq (26)		Eq (27)		Eq (28)		Eq (29)		Eq (30)		Eq (31)		Eq (32)	
Listed	0.031	***	0.243	***					0.182	***	0.185	***				
BREEAM	0.127		-0.012		0.068		0.073		-0.013		-0.012		0.063		0.067	
ESG					0.000								-0.001			
E							-0.006								-0.001	
S							0.005								0.005	
G							-0.001								-0.003	
Regulation	-0.035		-0.032		-0.066		-0.299									
Regulation* BREEAM	-0.173															
Regulation* Listed			-0.077													
Regulation*ESG					-0.001											
Regulation*E							0.006									
Regulation*S							-0.001									
Regulation*G							-0.003									
Covid									0.008		0.020		0.052		-0.577	
Covid*BREEAM																
Covid*Listed											-0.147					
Covid*ESG													-0.001			
Covid*E															0.022	
Covid*S															-0.010	
Covid*G															-0.005	
Constant	3.713	***	3.704	***	3.951	***	4.330	***	3.708	***	3.707	***	4.069	***	4.251	***
Number of obs	5,307		5,307		603		603		5,307		5,307		603		603	
Pseudo R2	0.337		0.337		0.369		0.373		0.336		0.336		0.367		0.37	
Log likelihood	26.20***		26.18***		4.71***		4.62***		26.13***		26.14***		4.68***		4.57***	

Retail sample. Dependent variable: natural log of effective rent/ sq ft p.a. A set of variables on physical attributes, geocodes, lease attributes, submarket, sign year and tenant industry sector are included in all regressions. Each column represents one separate regression. Estimated coefficients and their significance are reported. *P < 0.1; **P < 0.05; ***P < 0.01

Table 16: Hedonic regression estimates with the consideration of regulation and Covid, the industrial sample

	1		2		3		4		5		6		7		8	
	Eq (25)		Eq (26)		Eq (27)		Eq (28)		Eq (29)		Eq (30)		Eq (31)		Eq (32)	
Listed	0.038		0.018						0.039		0.033					
BREEAM	0.045		0.012		0.097		0.129		0.021		0.029		0.107		0.127	
ESG					0.003								0.001			
E							0.005	*							-0.001	
S							-0.005								0.004	**
G							-0.005								-0.002	
Regulation	-0.041		-0.045		0.213		-0.256									
Regulation* BREEAM	-0.044															
Regulation* Listed			0.026													
Regulation*ESG					-0.002											
Regulation*E							-0.008	**								
Regulation*S							0.010	***								

Regulation*G							0.004									
Covid									-0.229	***	-0.250	***	-0.234		-0.099	
Covid*BREEAM									0.048							
Covid*Listed											0.266					
Covid*ESG													0.005			
Covid*E															-0.014	
Covid*S															0.011	
Covid*G															0.004	
Constant	3.272	***	3.110	***	3.275	***	4.066	***	3.262	***	3.265	***	3.936	***	3.965	***
Number of obs	2,196		2,196		2,196		190		2,196		2,196		190		190	
Pseudo R2	0.342		0.342		0.342		0.606		0.346		0.347		0.562		0.575	
Log likelihood	14.93***		14.93***		14.93***		4.83***		15.15***		15.19***		4.37***		4.37***	

Industrial sample. Dependent variable: natural log of effective rent/ sq ft p.a. A set of variables on physical attributes, geocodes, lease attributes, submarket, sign year and tenant industry sector are included in all regressions. Each column represents one separate regression. Estimated coefficients and their significance are reported. *P < 0.1; **P < 0.05; ***P < 0.01

Chapter 8
Conclusion

As global concerns in sustainability, corporate responsibility, and social impact continue to grow, understanding occupiers' ESG initiatives has become increasingly relevant to property owners, managers, and policy makers. This study is one of the first few studies to provide quantitative evidence on occupiers' preference of, and WTP for, sustainable buildings with the consideration of their ESG profiles.

The summarised ESG trends based on the Refinitiv ESG database highlight the variations in ESG scores among countries and industries. In general, firms have exhibited an increase in ESG performance over the last 20 years. Particularly, there has been an increasing emphasis on the internal structure, policies and decision-making processes. In line with the global trends, occupiers' ESG scores in our samples also show an upward movement in ESG performance.

Our empirical findings are summarised as follows:

- We use publicly-listed tenants as a proxy for ESG-driven firms, as they are more likely to disclose their CSR policies and more likely to be concerned with their reputation and image, hence more likely to have emphasis on ESG. We find that publicly-listed tenants are indeed more likely to occupy a sustainable-labelled space, although this is only evident in the office sector.
- When ESG scores are included in analysis, we find some evidence of a relationship between governance structure and the preference of sustainable-labelled buildings in the office sector.
- Our hedonic models confirm a BREEAM-related premium, but again, this is only evident in the office market.
- The bargaining power of listed tenants in the office market in rent negotiations appears to be stronger since the introduction of minimum EPC rating regulation (which is likely to have increased the supply of more sustainable buildings) and during the Covid pandemic (when demand for offices significantly declined).
- In the retail and industrial sectors, however, we find little evidence of the impact of regulation and Covid on rental prices paid by listed firms or ESG-driven tenants.
- While tenants' overall ESG scores do not appear to affect the effective rents in all sectors, separate scores on the Social and Governance pillars do seem to have an impact on the effective rent.

The study contributes to the current discussion on ESG matters in real estate by evaluating tenants' environmental, social, and governance standards on the commercial space market and offers further insights for real estate practitioners and stakeholders. It shows that tenants' ESG or CSR considerations play a role in their building choice and are among the factors that drive the demand for sustainable buildings.

With the increasing focus on ESG, the desire among tenants for sustainable buildings could intensify, serving as a favourable market factor that propels the advance of the sustainable construction and retrofit agenda. This also suggests that the office market could potentially polarise, as the demand from occupiers decreases for properties that fall below a certain standard, leaving only those buildings with higher energy performance in the market.

The study also highlights that the WTP for more sustainable buildings is evident, but such willingness differs among occupiers with different ESG agendas. This suggests that while the income implications for investors are clear, building owners also need to consider tenant mix and weigh up the costs of implementing sustainable features against potential long-term savings and benefits.

The absence of green premiums in the industrial and retail sectors underscores the potential obstacles in enhancing building energy performance in these commercial real estate areas. These sectors could potentially gain from additional financial incentives or government intervention to help them move towards carbon emissions reduction targets.

For landlords and property managers, this study suggests not only that tenants' characteristics/covenant are incorporated in the pricing model of the asset, but that they can also impact on the long-term financial stability of rental income. Meeting tenants' ESG expectations can contribute to higher tenant satisfaction and retention rates.

Property managers and owners who prioritise sustainability and social responsibility are more likely to foster positive relationships with tenants, leading to longer lease durations and reduced vacancy rates. Furthermore, understanding occupiers' demand for sustainable buildings can further mitigate risks associated with regulatory changes, environmental liabilities, and changing market preferences.

For property valuers, tenants' ESG ratings can affect their default risk, credit ratings, level of profit, and access to the capital market. ESG performance and disclosure may therefore become a consideration in property valuation.

Regulations and unprecedented events can change the supply of, or demand for, sustainable spaces, which in turn influences the cashflows generated by commercial real estate. Our results imply that companies in the office sector that are more ESG-driven could potentially outbid those that are not. And occupiers' performance on the E, S and G pillars may present different merits

in rent negotiation. With our relatively small samples on ESG matters, it is difficult to truly make sense of all the coefficients estimated by our models and we will leave this for future research. Nevertheless, the analysis in this study provides further insights on ESG considerations in the commercial real estate context, so that stakeholders can make informed decisions about property investments, lease agreements, and property management strategies, ultimately creating a more sustainable future for the industry as a whole.

References

Adair, A; Hutchison, N E (2005). *The reporting of risk in real estate appraisal property risk scoring*. **Journal of Property Investment & Finance**, 23(3), pp254-268.

Allan R; Liusman, E; Lu, T; Tsang, D (2021). T*he COVID-19 Pandemic and Commercial Property Rent Dynamics*. **Journal of Risk and Financial Management**, 14(8), p360.

Alp, A (2013). *Structural shifts in credit rating standards*. **The Journal of Finance**, 68(6), pp2435-2470.

Ambrose, B W; Yildirim, Y (2008). *Credit risk and the term structure of lease rates: A reduced form approach*. **The Journal of Real Estate Finance and Economics**, Volume 37, pp. 281-298.

Why the built Envivornment **Architecture 2030** (Online) https://architecture2030.org/why-the-building-sector (Accessed 10 August 2023).

Arian, A G; Sands, J; Shams, S (2022). *The Impact of Corporate ESG Performance Disclosure Across Australian Industries*. **Australasian Accounting, Business and Finance Journal**, 16(4), pp180-200.

Asensio, O I; Delmas, M A (2017). *The effectiveness of US energy efficiency building labels*. **Nature Energy**, Volume 2, p17033.

Ashbaugh-Skaife, H; Collins, D W; LaFond, R (2006). *The effects of corporate governance on firms' credit ratings*. **Journal of Accounting and Economics**, 42(1-2), pp203-243.

Atif, M; Ali, S (2021). *Environmental, social and governance disclosure and default risk*. **Business Strategy and the Environment**, 30(8), pp3937-3959.

Attig, N; El Ghoul, S; Guedhami, O; Suh, J (2013). *Corporate Social Responsibility and Credit Ratings*. **Journal of Business Ethics**, 117(4), pp679-694.

Baghai, R P; Servaes, H; Tamayo, A (2014). *Have rating agencies become more conservative? Implications for capital structure and debt pricing*. **The Journal of Finance**, 69(5), pp1961-2005.

Barker, D; (2003). *Length of residence discounts, turnover, and demand elasticity. Should long-term tenants pay less than new tenants?* **Journal of Housing Economics**, 12(1), pp1-11.

Baron, D P; Harjoto, M A; Jo, H (2011). *The Economics and Politics of Corporate Social Performance*. **Business and Politics**, 13(2), pp1-46.

Bartlett, E; Howard, N (2000). *Informing the decision makers on the cost and value of green building*. **Building Research & Information**, 28(5-6), pp315-324.

Benjamin, J D; Boyle, G W; Sirmans, C F (1990). *Retail Leasing: The Determinants of Shopping Center Rents*. **Real Estate Economics**, 18(3), pp302-312.

Benjamin, J D; Boyle, G W; Sirmans, C F (1992). *Price discrimination in shopping center leases*. **Journal of Urban Economics**, 32(3), pp299-317.

Bhojrag, S; Sengupta, P (2003). *Effect of Corporate Governance on Bond Ratings and Yields: The Role of Institutional Investors and Outside Directors*. **The Journal of Business**, 76(3), pp455-475.

Bird, R et al (2007). *What Corporate Social Responsibility Activities are Valued by the Market?* **Journal of Business Ethics**, Volume 76, pp189-206.

Bolton, P; Freixas, X; Shapiro, J (2012). *The credit ratings game. T*he **Journal of Finance**, 67(1), pp85-111.

Brogi, M; Lagasio, V (2019). *Environmental, social, and governance and company profitability: Are financial intermediaries different?* **Corporate Social Responsibility and Environmental Management**, 26(3), pp576-587.

Brounen, D; Marcato, G; Op 'T Veld, H (2021). *Pricing ESG Equity Ratings and Underlying Data in Listed Real Estate Securities*. **Sustainability**, 13(4), p2037.

Cajias, M; Fuerst, F; Bienert, S (2014). *Can investing in corporate social responsibility lower a company's cost of capita*. **Studies in Economics and Finance**, 31(2), pp202-222.

Chegut, A; Eichholtz, P; Kok, N (2014). *Supply, Demand and the Value of Green Buildings*. **Urban Studies**, 51(1), pp22-43.

Cheng, B; Ionannou, I; Serafeim, G (2013). *Corporate social responsibility and access to finance*. **Strategic Manangement Journal**, 35(1), pp1-23.

Chinloy, P; Hardin, W I; Wu, Z (2013). *Price, Place, People, and Local Experience*. **Journal of Real Estate Research**, 35(4), pp477-506.

Cicchiello, A F; Marrazza, F (2022). *Non-financial disclosure regulation and environmental, social, and governance (ESG) performance: The case of EU and US firms*. **Corporate Social Responsibility and Environmental Management**, 30(3), pp1121-1128.

Cloutier, D (2020). *The New Norm: ESG as a Material Risk and Opportunity for Real Estate*. **Real Estate Issues**, 44(16), pp. 1-7.

Costa, O; Fuerst, F; Robinson, S J; Mendes-Da-Silva, W (2018). *Green label signals in an emerging real estate market. A case study of Sao Paulo, Brazil*. **Journal of Cleaner Production**, 184(20), pp. 660-670.

Crosby, N; Gibson, V; Oughton, M (2011). *Lease Structures, Terms and Lengths: Does the UK lease meet current business requirement? A Report on the Attitudes of Occupiers in the UK for the Royal Institution of Chartered Surveyors*, **University of Reading/RICS**.

Crosby, N; Jackson, C; Orr, A (2016). *Refining the real estate pricing model*. **Journal of Property Research**, 33(4), pp332-358.

Crosby, N; Murdoch, S (2000). *The influence of procedure on rent determination in the commercial property market of England and Wales*. **Journal of Property Investment & Finance**, 18(4), pp420-444.

Cupertino, S; Vitale, G; Ruggiero, P (2022). *Performance and (non) mandatory disclosure: the moderating role of the Directive 2014/95/EU*. **Journal of Applied Accounting Research**, 23(1), pp163-183.

Deng, X; Li, W; Ren, X (2023). *More sustainable, more productive: Evidence from ESG ratings and total factor productivity among listed Chinese firms*. **Finance Research Letters**, Volume 51, p103439.

Devine, A; Kok, N (2015). *Green Certification and Building Performance: Implications for Tangibles and Intangibles*. **The Journal of Portfolio Management**, 41(6), pp151-163.

Dhaliwal, D S; Li, O Z; Tsang, A; Yang, Y G (2011). *Voluntary Nonfinancial Disclosure and the Cost of Equity Capital: The Initiation of Corporate Social Responsibility Reporting*. **The Accounting Review**, 86(1), pp59-100.

Dixon, T; Ennis-Reynolds, G; Roberts, C; Sims, S (2009). *Is there a demand for sustainable offices? An analysis of UK business occupier moves (2006–2008)*. **Journal of Property Research**, 26(1), pp61-85.

Dubin, R A (1992). *Spatial autocorrelation and neighborhood quality*. **Regional Science and Urban Economics**, Volume 22, pp433-452.

Ehlers, T; Elsenhuber, U; Jegarasasingam, A; Jondeau, E (2022). Deconstructing ESG scores: How to invest with your own criteria, **Bank for International Settlements**.

Eichholtz, P; Kok, N; Quigley, J M (2010). *Doing well by doing good? Green office buildings*. **American Economic Review**, 100(5), pp2492-2509.

Eichholtz, P; Kok, N; Quigley, J M (2013). *The economics of green building*. **Review of Economics and Statistics**, 95(1), pp50-63.

Feng, Z; Wu, Z (2021). *ESG disclosure, REIT debt financing and firm value*. **The Journal of Real Estate Finance and Economics**, pp1-35.

Fintech Global (2023). *Chinese firms embracing ESG strategies to meet growing demand, survey finds*. (Online) Available at: https://fintech.global/2023/05/30/chinese-firms-embracing-esg-strategies-to-meet-growing-demand-survey-finds/ [Accessed 5 September 2023].

Fiorentino, S; Livingstone, N; McAllister, P; Cooke, H (2022). *The future of the corporate office? Emerging trends in the post-Covid city*. **Cambridge Journal of Regions, Economy and Society**, 15(3), pp597-614.

Fisher, J; Lentz, G (1990). *Business enterprise value in shopping malls: an empirical test*. **Journal of Real Estate Research**, 5(1), pp167-175.

Fombrun, C; Shanley, M (1990). *What's in a Name? Reputation Building and Corporate Strategy*. **Academy of Management Journal**, 33(2), pp233-258.

Friede, G; Busch, T; Bassen, A (2015). *ESG and financial performance: aggregated evidence from more than 2000 empirical studies*. **Journal of Sustainable Finance & Investment**, 5(4), pp210-233.

Fuerst, F; McAllister, P (2011a). *Eco-labeling in commercial office markets: Do LEED and Energy Star offices obtain multiple premiums?* **Ecological Economics**, Volume 70, pp1220-1230.

Fuerst, F; McAllister, P (2011b). *Green Noise or Green Value? Measuring the Effects of Environmental Certification on Office Values*. **Real Estate Economics**, 39(1), pp45-69.

Fuerst, F; McAllister, P (2011c). *The impact of Energy Performance Certificates on the rental and capital values of commercial property assets*. **Energy Policy**, 39(10), pp6609-6614.

Fuerst, F; van de Wetering, J (2015). *How does Environmental Efficiency Impact on the Rents of Commercial Offices in the UK?* **Journal of Property Research**, 32(3), pp193-216.

Fuerst, F; van de Wetering, J; Wyatt, P (2013). *Is intrinsic energy efficiency reflected in the pricing of office leases?* **Building Research & Information**, 41(4), pp0373-383.

Gabe, J; Rehm, M (2014). *Do tenants pay energy efficiency rent premiums?* **Journal of Property Investment & Finance**, 32(4), pp333-351.

Gatzlaff, D H; Sirmans, G S; Diskin, B A (1994). *The effect of anchor tenant loss on shopping center rents*. **Journal of Real Estate Research**, 9(1), pp99-110.

Gerbrich, M (1998). *Shopping Center Rentals: An Empirical Analysis of the Retail Tenant Mix*. **The Journal of Real Estate Research**, 15(3), pp283-296.

Giese, G et al (2019). *Foundations of ESG Investing: How ESG Affects Equity Valuation, Risk, and Performance*. **The Journal of Portfolio Management**, 45(5), pp69-83.

Grenadier, S R (2005). *An Equilibrium Analysis of Real Estate Leases*. **The Journal of Business**, 78(4), pp1173-1214.

Grendadier, S R (1995). V*aluing lease contracts a real-options approach*. **Journal of Financial Economics**, 38(3), pp297-331.

Gui, X; Gou, Z (2021). *Understanding green building energy performance in the context of commercial estates: A multi-year and cross-region analysis using the Australian commercial building disclosure database*. **Energy**, Vol 222, p119988.

Hao, F; Xiao, Q; Chon, K (2020). *COVID-19 and China's Hotel Industry: Impacts, a Disaster Management Framework, and Post-Pandemic Agenda*. **International Journal of Hospitality Management**, Vol 90, p102636.

Hensher, D A; Wei, E; Beck, M J (2023). *The impact of COVID-19 and working from home on the workspace retained at the main location office space and the future use of satellite offices*. **Transport Policy**, Vol 130, pp184-195.

Hoepner, A G; Yu, P-S (2010). *Corporate Social Responsibility Across Industries: When Can Who Do Well by Doing Good?* **Social Science Research Network**, p1284703.

Holtermans, R; Kok, N (2019). *On the Value of Environmental Certification in the Commercial Real Estate Market*. **Real Estate Economics**, 47(3), pp685-722.

Hutchison, N E; Adair, A; McWilliam, J (2008). *Covenant strength in shopping centres: a diversified risk?* **Journal of Property Investment & Finance**, 26(4), pp329-341.

Hutchison, N E; Adair, A S; Findlay, N (2011). *The impact of covenant strength on property pricing*. **Journal of Property Research**, 28(2), pp167-188.

Jang, D.-C; Kim, B; Kim, S H (2018). *The effect of green building certification on potential tenants' willingness to rent space in a building*. **Journal of Cleaner Production**, 194(1), pp645-655.

Jeong, J et al (2016). *Development of an evaluation process for green and non-green buildings focused on energy performance of G-SEED and LEED*. **Building and Environment**, Vol 105, pp172-184.

Khan, M E; Kotchen, M (2010). *Environmental Concern and the Business Cycle: The Chilling Effect of Recession*. **National Bureau of Economic Research**.

Kibert, C J (2016). *Sustainable construction: green building design and delivery*. **John Wiley & Sons**.

Kilcioglu, C; Zubizarreta, J R (2016). *Maximizing the information content of a balanced matched sample in a study of the economic performance of green buildings*. **The Annals of Applied Statistics**, 10(4), pp1997-2020.

Kok, N; Jennen, M (2012). *The impact of energy labels and accessibility on office rents*. **Energy Policy**, Vol 46, pp489-497.

Kok, N; Miller, N; Morris, P (2012). *The Economics of Green Retrofits*. **Journal of Sustainable Real Estate**, 4(1), pp4-22.

Leder, S et al (2016). *Effects of office environment on employee satisfaction: a new analysis*. **Building Research & Information**, 44(1), pp34-50.

Levy, D; Peterson, G (2013). *The effect of sustainability on commercial occupiers' building choice*. **Journal of Property Investment & Finance**, 31(3), pp267-284.

Li, H; Zhang, X; Zhao, Y (2022). *ESG and Firm's Default Risk*. **Finance Research Letters**, 47(Part B), p102713.

Ling, D C; Petrova, M (2008). *Avoiding Taxes at Any Cost: The Economics of Tax-deferredReal Estate Exchanges*. **The Journal of Real Estate Finance and Economics**, Vol 36, pp367-404.

Livingstone, N; Ferm, J (2017). *Occupier responses to sustainable real estate: what's next?* **Journal of Corporate Real Estate**, 19(1), pp5-16.

Miller, E; Buys, L (2008). *Retrofitting commercial office buildings for sustainability: tenants' perspectives*. **Journal of Property Investment & Finance**, 26(6), pp552-561.

Miller, N; Spivey, J; Florance, A (2008). *Does green pay off?* **Journal of Real Estate Portfolio Management**, 14(4), pp385-400.

Ministry of Housing, Communities & Local Government (2021). *Rigorous new targets for green building revolution*. (Online) Available at: https://www.gov.uk/government/news/rigorous-new-targets-for-green-building-revolution [Accessed 10 August 2023].

Mulchandani, K; Mulchandani, K; Iyer, G; Lonare, A (2022). *Do Equity Investors Care about Environment, Social and Governance (ESG) Disclosure Performance? Evidence from India*. **Global Business Review**, 23(6), pp1336-1352.

Myers, G; Reed, R; Robinson, J (2008). *Sustainable Property – The Future of the New Zealand Market*. **Pacific Rim Property Research Journal**, 14(3), pp298-321.

Nase, I; van Assendelft, N; Remøy, H (2019). *Rent Premiums and Vertical Sorting in Amsterdam's Multi-Tenant Office Buildings*. **The Journal of Real Estate Finance and Economics**, Volume 59, pp419-460.

Newell, G; MacFarlane, J; Walker, R (2014). *Assessing Energy Rating Premiums in the Performance of Green Office Buildings in Australia*. **Journal of Property Investment & Finance**, 32(4), pp352-370.

Newell, G; Marzuki, M J (2022). *The increasing importance of environmental sustainability in global real estate investment markets*. **Journal of Property Investment & Finance**, 40(4), pp411-429.

Newell, G; Nanda, A; Moss, A (2023). *Improving the benchmarking of ESG in real estate investment*. **Journal of Property Investment & Finance**, 41(4), pp380-405.

Newsham, G R; Mancini, S; Birt, B J (2009). *Do LEED-certified buildings save energy? Yes, but…* **Energy and Buildings**, 41(8), pp897-905.

Nicholas, T; Scherbina, A (2013). *Real estate prices during the roaring twenties and the great depression*. **Real Estate Economics**, 41(2), pp278-309.

Oladiran, O; Hallam, P; Elliot, L (2023). *The COVID-19 pandemic and office space demand dynamics*. **International Journal of Strategic Property Management**, 27(1), pp35-49.

Onishi, J; Deng, Y; Shimizu, C (2021). *Green Premium in the Tokyo Office Rent Market*. **Sustainability**, 13(21), p12227.

O'Roarty, B; McGreal, S; Adair, A (1997). *The impact of retailers' store selection criteria on the estimation of retail rents*. **Journal of Property Valuation and Investment**, 15(2), pp119-130.

Orr, A M; Gardner, A; Jackson, C; White, J T (2023). *Changing tenant covenant perceptions and flexibility in the lease model in UK city centres*. **Journal of Property Research**, 40(1), pp1-24.

Ortiz, M A; Bluyssen, P M (2022). *Profiling office workers based on their self-reported preferences of indoor environmental quality and psychosocial comfort at their workplace during COVID-19*. **Building and Environment**, Vol 211, p108742.

Ott, C; Hahn, J (2018). *Green pay off in commercial real estate in Germany: assessing the role of Super Trophy status*. **Journal of Property Investment & Finance**, 36(1), pp104-124.

Parker, L D (2020). *The COVID-19 office in transition: cost, efficiency and the social responsibility business case*. **Accounting, Auditing & Accountability Journal**, 33(8), pp1943-1967.

Pivo, G; Fisher, J D (2010). *Income, Value, and Returns in Socially Responsible Office Properties*. **Journal of Real Estate Research**, 32(3), pp243-270.

Porter, M E; van der Lind, C (1995). *Toward a New Conception of the Environment-Competitiveness Relationship*. **Journal of Economic Perspectives**, 9(4), pp97-118.

Qiu, Y; Kahn, M E (2019). *Impact of voluntary green certification on building energy performance*. **Energy Economics**, Vol 80, pp461-475.

Raimo, N; Caragnano, A; Zito, M; Vitolla, F (2021). *Extending the benefits of ESG disclosure: The effect on the cost of debt financing*. **Corporate Social Responsibility and Environmental Management**, 28(4), pp1412-1421.

Reed, R G; Wilkinson, S J (2005). *The increasing importance of sustainability for building ownership*. **Journal of Corporate Real Estate**, 7(4), pp339-350.

Reichardt, A (2014). *Operating Expenses and the Rent Premium of Energy Star and LEED Certified Buildings in the Central and Eastern US*. **The Journal of Real Estate Finance and Economics**, 49(3), pp413-433.

Reichardt, A; Fuerst, F; Rottke, N B; Zietz, J (2012). *Sustainable Building Certification and the Rent Premium: A Panel Data Approach*. **Journal of Real Estate Research**, 34(1), pp99-126.

RICS (2022). *Sustainability and ESG in commercial property valuation and strategic advice*, Global, 3rd Edition, London, **The Royal Institution of Chartered Surveyors**.

Robinson, S J; McAllister, P (2015). *Heterogeneous price premiums in sustainable real estate? An investigation of the relation between value and price premiums*. **Journal of Sustainable Real Estate**, 7(1), pp1-20.

Robinson, S J; Sanderford, A R (2016). *Green Buildings: Similar to Other Premium Buildings?* **The Journal of Real Estate Finance and Economics**, Vol 52, pp99-116.

Robinson, S; Simons, R; Eunkyu, L (2017). *Which Green Office Building Features Do Tenants Pay For? A Study of Observed Rental Effects*. **The Journal of Real Estate Research**, 39(4), pp467-492.

Robinson, S; Simons, R; Lee, E; Kern, A (2016). *Demand for Green Buildings: Office Tenants' Stated Willingness-to-Pay for Green Features*. **Journal of Real Estate Research**, 38(3), pp423-452.

Roh, T et al (2021). *Indoor Air Quality and Health Outcomes in Employees Working from Home during the COVID-19 Pandemic: A Pilot Study*. **Atmosphere**, 12(12), p1665.

Rosenthal, S S; Strange, W C; Urrego J (2022). *JUE insight: Are city centers losing their appeal? Commercial real estate, urban spatial structure, and COVID-19*. **Journal of Urban Economics**, Vol 127, p103381.

Sachin, N; Rajesh, R (2022). *An empirical study of supply chain sustainability with financial performances of Indian firms*. **Environment, Development and Sustainability**, Vol 24, pp6577-6601.

Sayce, S; Smith, J; Cooper, R; Venmore-Rowland, P (2006). *Real Estate Appraisal: From Value to Worth*. Oxford, **Blackwell**.

Sayce, S; Sundberg, A; Parnell, P; Cowling, E (2009). *Greening leases: Do tenants in the United Kingdom want green leases?* **Journal of Retail & Leisure Property**, Vol 8, pp273-284.

Scofield, J H (2009). *Do LEED-certified buildings save energy? Not really…* **Energy and Buildings**, 41(12), pp1386-1390.

Seyler, N J; Mutl, J (2019). *Going beyond buildings: mindfulness and real estate user behavior*. **Journal of Corporate Real Estate**, 21(3), pp194-211.

Sirmans, C F; Guidry, K A (1993). *The Determinants of Shopping Center Rents*. **The Journal of Real Estate Research**, 8(1), pp107-115.

Sturgis, S (2020). T*he RICS Whole life carbon assessment for the built environment: how, why and what next?* (Online) Available at: https://ww3.rics.org/uk/en/journals/construction-journal/the-rics-whole-life-carbon-assessment-for-the-built-environment-how-why-and-what-next.html [Accessed 10 August 2023].

Szumilo, N; Fuerst, F (2013). *The Operating Expense Puzzle of U.S. Green Office Buildings*. **Journal of Sustainable Real Estate**, 5(1), pp86-110.

Szumilo, N; Fuerst, F (2017). *Income Risk in Energy Efficient Office Buildings*. **Sustainable Cities and Society**, Vol 34, pp309-320.

Tanrıvermiş, H (2020). *Possible impacts of COVID-19 outbreak on real estate sector and possible changes to adopt: A situation analysis and general assessment on Turkish perspective*. **Journal of Urban Management**, 9(3), pp263-269.

Tayan, B (2022). ESG Ratings: A Compass without Direction. The State of Climate Disclosure and Governance.

Tay, R; Lau, C; Leung, M (1999). *The determination of rent in shopping centers: some evidence from Hong Kong*. **Journal of Real Estate Literature**, 7(2), pp183-196.

Thatcher, A; Milner, K (2014). *Changes in productivity, psychological wellbeing and physical wellbeing from working in a 'green' building*. **Work**, 49(3), pp381-391.

Thatcher, A; Milner, K (2016). *Is a green building really better for building occupants? A longitudinal evaluation*. **Building and Environment**, 108(1), pp. 194-206.

Turban, D; Greening, D W (1997). *Corporate Social Performance And Organizational Attractiveness To Prospective Employees*. **Academy of Management Journal**, 40(3), pp658-672.

Turner, C; Frankel, M (2008). *Energy Performance of LEED® for New Contruction Buildings*. **New Buildings Institute**, 4(4), pp1-42.

Veld, H O; Vlasveld, M (2014). *The effect of sustainability on retail values, rents, and investment performance: European evidence*. **Journal of Sustainable Real Estate**, 6(2), pp163-185.

Weber, O; Scholz, R W; Michalik, G (2010). *Incorporating Sustainability Criteria into Credit Risk Management*. **Business Strategy and the Environment**, 19(1), pp39-50.

Wen, Y; Fang, L; Li, Q (2022). C*ommercial Real Estate Market at a Crossroads: The Impact of COVID-19 and the Implications to Future Cities*. **Sustainability**, 14(19), p12851.

Wheaton, W C (1990). *Vacancy, Search, and Prices in a Housing Market Matching Model*. **Journal of Political Economy**, 98(6), pp1270-1292.

Wiley, J A; Benefield, J D; Johnson, K H (2010). *Green Design and the Market for Commercial Office Space*. **Journal of Real Estate Finance and Economics**, Vol 41, pp228-243.

Yoo, S; Managi, S (2022). *Disclosure or action: Evaluating ESG behavior towards financial performance*. **Finance Research Letters**, Volume 44, p102108.

Yu, E P-y; Guo, C Q; Van Luu, B (2018). *Environmental, social and governance transparency and firm value*. **Business Strategy and the Environment**, 27(7), pp987-1004.

Zhang, Y; Nakajima, T; Hamori, S (2021). *How does the environmental, social, and governance index impacts the financial market and macro-economy?* **Springer**.