Journal of Property Research

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rjpr20

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Qiulin Ke

To cite this article: Qiulin Ke (14 Sep 2024): The economic value of end-of-trip facilities for cyclist commuter in an office building, Journal of Property Research, DOI: 10.1080/09599916.2024.2403979

To link to this article: https://doi.org/10.1080/09599916.2024.2403979

Published online: 14 Sep 2024.

JOURNAL OF PROPERTY RESEARCH
https://doi.org/10.1080/09599916.2024.2403979

The economic value of end-of-trip facilities for cyclist commuter in an office building

Qiulin Ke

The Bartlett School of Planning, University College London, London, UK

ABSTRACT

The paper aims to investigate whether the presence of cycling-supportive facilities could add value to office buildings. Cycling to work offers numerous advantages for individuals, employers, the environment, and society, ranging from improved physical health, wellbeing and productivity to enhanced public health and reduced carbon emissions. However, the absence of secure bike parking and storage and shower and changing facilities (referred to as end-of-trip facilities) at workplace is identified as one of the hindrances to prevent more people from cycling to work. In this paper, we investigate whether office occupants are willing to pay rent premium for the end-of-trip facilities in an office building. The study uses data of office buildings across England as of the end of 2021. Hedonic technique is employed to examine whether office buildings with bike storage and shower facility command a rent premium. It is found that the buildings with bike storage and shower facility secure rent premiums, irrelevant of size and age of building and independently from any premium associated with BREEM certification. The level of rent premiums varies with location and region and is mainly driven by the shortage of the supply of these facilities.

ARTICLE HISTORY
Received 31 March 2024
Accepted 9 September 2024

KEYWORDS
Rent premiums; cycling to work; bike storage; shower facility; office building

Introduction

The paper investigates the economic value of end-of-trip facilities (namely, bike storage and shower/changing facility) in the context of office buildings and explores whether these sustainable features could lead to rent premiums for office buildings in England.

In recent years, commuting by bike has attained significant attention from the transportation, environmental, and health sectors. Cycling increases physical activity levels, leading to a multitude of health benefits (Cavill et al., 2008; Oja et al., 2011), while also mitigating air pollution, carbon emissions, congestion, noise, and other detrimental impacts associated with car use (Brand, 2021; Brand et al., 2014, 2022; Götschi et al., 2016). Consequently, cycling and walking are recognised as sustainable transportation modes. Government agencies in many countries, cities, and towns have actively promoted cycling by investing in travel-related infrastructure, programs and

CONTACT Qiulin Ke q.ke@ucl.ac.uk

policy interventions aimed at encouraging bicycling (Pucher et al., 2010). Over the last three decades, bicycling has experienced significant growth (Buehler & Pucher, 2021).

There is a consensus regarding the importance of providing quality bike parking/storage for cyclists, particularly secure and sheltered facilities to prevent theft and protect bicycles from harsh weather conditions (Buehler, 2012; Hamre & Buehler, 2014; Heinen et al., 2013). Commuters who cycle to work often face challenges such as arriving wet or sweaty. Providing employees with access to shower, changing rooms, and storage facilities can encourage more bicycle commuting. Bicycle parking, storage, and shower rooms, collectively referred to as end-of-trip facilities, play a crucial role in offering convenience and security to cyclists at their destinations. The lack of adequate facilities at destinations and concerns about theft is recognised as significant deterrents to bicycle transportation (Fowler et al., 2017; Nkurunziza et al., 2012).

The benefits of the cycle-to-work initiative for employers are widely acknowledged, such as chronic disease prevention and favourable impact on antecedent risk factors such as high blood pressure, obesity and well-being (Garrard et al., 2012; Gatersleben & Haddad, 2010; Götschi et al., 2016; Oja et al., 2011). Therefore, to encourage more employees to cycle to work, employers may be willing to occupy buildings equipped with end-of-trip facilities for cyclist employees. Consequently, there is a strong demand for these features in office buildings. According to a survey conducted by CBRE, bike storage and shower facilities in an office building made the top five list of valuable social building features. Nearly half of the respondents (occupiers and investors) are willing to pay a premium for these features (CBRE, 2023). However, despite their perceived benefits, the economic implications of these features in a building remain unknown.

In this paper, we aim to investigate whether office buildings with green features such as on-site bike storage and shower and changing facility could enhance the value of the office space. Given the compelling evidence suggesting that cycling to work improves employee health and productivity, tenants may be willing to pay rent premiums for office buildings equipped with such green features.

Using a sample comprising 12,469 office buildings in England as of the end of 2021, we employ hedonic technique to address the following objectives: (1). Exploring whether office buildings with bike storage and/or shower facility can secure rent premiums; (2). Examine whether the size and age of building affects the presence of these facilities in an office building; (3). Investigate whether the level of rent premiums for bike storage and/or shower facility varies by location and across regions in England, and whether it is independent from the premium associated with a BREEM certificate.

Our study finds that buildings with bike storage or shower facility command rent premiums, regardless of the size and age of a building. Furthermore, there are variations in these premiums across different regions in England. The premiums are driven by strong demand for and shortage of supply of these facilities. The findings also provide evidence that the benefit of the presence of such facilities exceeds the costs of installing them in a building.

The findings of this study hold significant indications for commercial real estate landlord/investor, developer and property manager. The provision of bike storage and shower facility not only benefits the environment and occupant's well-being but also offers tangible financial advantages to landlord/investor. As sustainability continues to drive the real estate market, investing in green building practices is not only morally commendable but also a smart business decision.

The remainder of the paper is structured as follows. Next, relevant literature is reviewed, followed by a discussion of the data and methodology employed, and then the empirical test findings are reported and discussed. Finally, conclusions are drawn based on the results of the study.

Literature review

Research indicates that cycling, as a form of physical activity, can significantly enhance both mental and physical health (Ma et al., 2021; M. Martin et al., 2014; Stamatakis et al., 2007). Moreover, by substituting for car trips, cycling can effectively reduce greenhouse gas emissions and contribute to improving air quality. Therefore, cycling and walking are recognised as sustainable transportation modes and are actively promoted by governments and their agencies in many countries as a means to improve individual health and address various environmental challenges. Bicycling is recognised as a solution to mitigate air pollution, carbon emissions, congestion, noise, traffic hazards, and other negative impacts associated with car usage (Banister, 2008; Giles-Corti et al., 2019; Godlee, 1992). To encourage bicycling, various transportation policies and strategies have been implemented, incorporating a wide range of infrastructural interventions (Graham-Rowe et al., 2011). These interventions include measures such as separating cyclists from motor vehicles, implementing two-way travel on one-way streets, incorporating separate traffic signal phases for bicycles at intersections, establishing car-free zones, and introducing bicycle boxes, among others (Pucher et al., 2010).

However, infrastructure alone may not suffice to promote active cycling. Demographic and socio-economic characteristics also influence travel behaviour (Pucher & Buehler, 2006). For instance, A. Martin et al. (2021) discovered there was a correlation between lower incomes and a decreased share of cycling for commuting in London. Additionally, studies on bicycle commuting have found that factors such as age, physical fitness, gender, employment status, education, car ownership, and cultural influences are significantly related to cycling for commuting purposes (Aldred & Jungnickel, 2014; Heinen et al., 2010; Moudon et al., 2005).

The U.K. government introduced the Cycle to Work scheme in the 1999 Finance Act. This initiative effectively reduces the purchase price of a new bike for employees through a tax exemption. The primary aim of the scheme is to promote commuting to work by bike, encouraging physical exercise, while simultaneously reducing pollution. Currently, the scheme has garnered participation from over 40,000 employers' nationwide, facilitating more than 1.6 million commuters cycling to work, as reported by the Cycle to Work Alliance, a coalition of the five largest providers of the Cycle to Work scheme in the U.K.

The strategies implemented by the U.K. government also include enhancing cycle safety, developing cycle-friendly infrastructure, providing adequate cycle parking, reducing theft, reallocating travel incentives, and raising public awareness (Department for Transport, 2005). Over the past few decades, significant investments have been made in bicycle-friendly infrastructure throughout the U.K (Powell et al., 2010; Song et al., 2017). Towns and cities across the U.K. have adopted their own initiatives tailored to their specific needs. These initiatives encompass a combination of capital investment, such as the construction of cycle lanes, and revenue investment, such as cycle training programs. These efforts have led to a notable increase in cycling to work across the country (Goodman et al., 2013).

Research investigating the factors influencing the propensity for cycling to work has identified end-of-trip facilities, such as secure indoor bike storage, showers, and places to store a change of clothing, as significant influencers (Wardman et al., 2007; Winters et al., 2010). Achieving substantial increases in cycling rates necessitates an integrated package of various complementary workplace infrastructures. Provision of pro-cycling facilities at workplace also reflects the employers' attitudes towards promoting cycling-to-work initiatives, which significantly influences employees' decision to cycle (Hamre & Buehler, 2014; Heinen et al., 2013). For example, multivariate analysis of the UK National Travel Survey by Wardman et al. (2007) found that compared to a base bicycle mode share of 5.8% for work trips, outdoor parking would raise the share to 6.3%, indoor secure parking to 6.6%, and indoor parking plus showers to 7.1%. This analysis provides strong evidence that end-of-trip facilities at the workplace have a significant impact on the decision to cycle to work.

The provision of these facilities in buildings has been increasing due to building codes in some cities that mandate such facilities and are encouraged by green building codes such as LEED and BREEAM, which award credit points for such features. For example, in the transport section of BREEM assessment criteria, 1 credit can be obtained for installing bike storage to meet BREEAM regulations, while an additional credit is available by incorporating at least two of the following criteria: showers (1 for every 10 bike parking spaces), changing facilities and lockers, and drying facilities for clothes (BREEAM In-Use technical manuals, 2020).

However, the number of buildings with BREEM or LEED certification remains relatively small within the total existing building stock. Concurrently, the demand for facilities catering to pro-cycling to work is increasing as more individuals opt to cycle to work. Therefore, the provision of such facilities at the workplace is crucial.

Rosen's hedonic pricing method (1974) suggests that the value of property is determined by the sum of building characteristics and characteristics of its surrounding environment. Therefore, the price of one property relative to another will differ with the additional unit of the different attributes inherent in one property relative to another one and market demands and supplies of these attributes at any given time and place determine the prices. The empirical studies utilising this model find that the physical features of office buildings such as the height, age, size, distance to the Central Business, amenities and accessibility have significant impact on rents (Bollinger et al., 1998; Dunse & Jones, 1998; Mills, 1992; Slade, 2000; Nappi-Choulet et al., 2007). The existing literature also suggests that buildings certified with BREEM or LEED provide financial benefits such as premiums on sales price or rent (Eichholtz et al., 2010; Leskinen et al., 2020; Reichardt et al., 2012). For instance, Reichardt et al. (2012) found rental premium for both ENERGY STAR and LEED certified office buildings during 2000–2010 period in the U.S market. Ghosh and Petrova (2023) found that rent income and transaction prices of certified properties are higher than non-certified properties in the Western European office markets. They argued that premiums are driven by the shortage of the supply of green buildings and strong demand for them in the market. These studies suggest that 'green building' label could be the key factor driving rental premium for certified buildings, but they could not fully explain the causes of the higher rental prices or which green features lead to rent premium.

Certain building features have been identified to impact the value of commercial real estate. For instance, features such as daylighting and electric vehicle (EV) charging station have been found to influence the value of U.S. commercial real estate, independently of LEED certification (Freybote, 2023; Robinson & Sanderford, 2016; Turan et al., 2020). However, research into the impact of individual building features on occupant wellbeing, productivity, and overall building value remains relatively scarce. In the U.S market, Robinson and Sanderford (2016) analysed the demand for green office building features among office tenants through a survey. While 18 green features were included in the survey and ranked by participants, on-site showers ranked seventh to last, and bike racks at the building ranked fourth to last in desired green building features. Robinson et al. (2017) empirically analysed the impact of 15 green features of office buildings on rental values in the U.S. market and found that on-site bicycle storage had no significant impact on rental value, whereas on-site showers did, even though bicycle parking facilities are typically associated with showers. There is variation in cycling levels among countries and cities. The cycling levels in U.S are much lower than in Europe and U.K (Buehler & Pucher, 2012, 2021), which may explain why bike storage is regarded as less valuable there. However, the findings from the studies conducted in the U.S. market may not necessarily apply directly to the market dynamics in England (Kazemzadeh et al., 2020). Further research specific to the U.K. context would help to better understand the implications of such green features in the commercial real estate market. However, there is limited research examining the value of individual green features in office spaces in the U.K.

Methodology

The central question of the study is whether providing bike storage and shower facilities in an office building can enhance its value. The theoretical model draws from Rosen's work, which posits that a property's market price results from a combination of structural features (such as size, age, bike storage, shower), environmental attributes (e.g. BREEM certification and EPC ratings), and locational factors (such as accessibility to transportation hubs, in urban or suburban). The hedonic model has been predominantly employed in previous studies analysing rent or sale premiums for commercial buildings (e.g. Chegut et al., 2014; Fuerst & Van De Wetering, 2015; Robinson & Sanderford, 2016). Following the literature review, the model is constructed as follows.

$$R_i = X_i\beta + \varepsilon_i \qquad (1)$$

Where the dependent variable (rent per square foot) is regressed on a vector, X, of office building characteristics. The model operates under the assumption that individual building components contribute independently to the overall rent. These can be subdivided into the presence of green features and other office characteristics and location. The stochastic disturbance term, ε, is assumed to follow the standard assumptions of zero mean and constant variance. The model in (1) is estimated in log-linear form as:

$$LogRent_i = \alpha + \beta_1 \sum_{i=1}^{N} Green\,features + \beta_2 \sum_{i=1}^{N} Characteristics + \beta_3 \sum_{i=1}^{N} Locations + \varepsilon_i \qquad (2)$$

Where LogRent represents the natural logarithm of the average asking rent for a particular property i; green features are the presence of bike storage or shower facility in building i. Other characteristics are size, age, renovation status, BREEM certification, and Energy Performance Certificate (EPC) of building i. The square of the age is controlled to address potential nonlinear price effects for old properties. Additionally, interaction terms for BREEM and bike storage, as well as BREEM and shower, are included to assess whether a rent premium exists independently of the green certificate. The locational characteristics of building i are the logarithm of the distance in metre to the nearest tube/train station, urban versus suburban location, and whether the building is situated in London or in one of the regions outside London: East England (EE), West Midlands (WM), South East (SE), South West (SW), North East (NE), North West (NW), and Yorkshire and the Humber (YH). East Midlands (EM) serves as the reference group and is not included in the model. Ɛ denotes the error term.

The key assumptions of OLS model are homoscedasticity and the disturbance term has zero mean. The data in the tests are cross-sectional, and the office market is highly heterogeneous. It is likely that the error term does not meet these assumptions. Therefore, Breusch-Pagan and White's tests are also run to test for heteroscedasticity.

Data

Office building data in England were collected from CoStar. The CoStar dataset comprises a comprehensive range of information, including the building's address, physical characteristics such as size, number of floors, year of construction, renovation history, and various features such as food service, bicycle storage, skylights, showers, etc. Additionally, the CoStar dataset contains information on the BREEM rating of the building. However, the data on Energy Performance Certificates (EPC) are incomplete. To address this, we supplemented the EPC data from the Department for Levelling Up, Housing, and Communities for the office buildings.

For our study, owner-occupied buildings have been excluded as they do not generate rental income.The original dataset contains 13,111 buildings. 642 buildings were excluded: 129 of them are owner-occupied, and 513 of them did not disclose rent information. The final dataset consists of 12,469 office buildings occupied by tenants across eight regions in England, all of which have complete information and are included in the analysis.

The rents are average asking rents per square foot of office buildings as of the end of 2021. The asking rent does not consider the rental free period and could be different from the effective rent. Since the effective rent is not available, asking rent is used. The independent variables of interest include bicycle storage (Bike) and shower facility (Shower), which are binary variables coded as 1 if a building has bicycle storage or a shower facility, respectively. Additionally, we control building size, measured by square feet of building's net internal area, and building age, measured as the age of the building up to the end of 2021 adjusted by the renovation year. We also account for accessibility by measuring the direct distance of a building to the nearest tube or train station in metres. These variables are identified to have a significant impact on rent or price of a property and controlled in similar studies (Chegut et al., 2014; Mills, 1992; Nappi-Choulet et al., 2007; Slade, 2000).

We perform logarithmic transformations on both the dependent and independent variables in the regression analysis, as the original values of rent, age, size and distance to the nearest tube/train station are not normally distributed. The log transformed values of them are more symmetrical. To control for green building certifications, binary variables are created for buildings with BREEM or Energy Performance Certificate (EPC) ratings, respectively. Other variables included in the analysis are renovation since 2000, represented as a binary variable coded as 1 if the building was renovated since 2000. The location variables include urban area versus suburban area, with a binary variable coded as 1 if the building is located in an urban area including the central business district (CBD), and 0 otherwise. To account for regional effects, binary variables are created for East England (EE), East Midlands (EM), West Midlands (WM), South East (SE), South West (SW), North East (NE), North West (NW), and Yorkshire and the Humber (YH), with East Midlands (EM) serving as the reference group.

Table 1 presents the descriptive statistics of the study variables. Panel A summarises the full sample, indicating that 1,246 buildings (10%) have bike storage, and 1,496 buildings (12%) have shower facility. Additionally, 1,495 buildings (12%) are certified with BREEM, and 8,600 buildings (69%) have Energy Performance Certificate (EPC). Notably, 49% of the buildings are situated in urban areas, including central business districts (CBDs). London is the largest office market, encompassing 39% of the total sample.

Green building practices, such as eco-certification, are influenced by economic conditions in specific markets (Dippold et al., 2014). Therefore, we conducted parametric t-tests with unequal variances for these variables. The results are presented in Panel B of Table 1.

Panel B outlines the outcomes of the parametric t-tests with unequal variances for these variables. Distinct differences are observed between properties with and without bike storage. Buildings with bike storage exhibit significantly higher rents, larger sizes, younger ages, and closer proximities to the nearest tube/train stations compared to those without bike storage. Moreover, a higher proportion of buildings with bike storage (35%) are certified with BREEM, compared to the ones without bike storage (9%), reflecting the incorporation of this feature in BREEM assessments. However, the proportion of buildings with Energy Performance Certificate (EPC) is lower (63%) among those with bike storage, compared to the ones without bike storage (70%). Additionally, 71% of buildings with bike storage have shower facility and 38% of them have been renovated since 2000. 79% of them are located in urban areas. These ratios are significantly higher than their counterparts without bike storage. The results indicate that green features, such as bike storage and shower facility, can be found in non-certified buildings. Additionally, some BREEAM-certified buildings may lack these features. Therefore, it is essential to investigate the economic value of these green features independently of BREEAM certification.

Table 1. Descriptive statistics tests of study variables.

	Mean	Min.	Max.	Std. Dev
Panel A: Summary of full sample (*N* = 12,465)				
Rent	26.58	1.31	189	19.57
Size	31797.37	30	1400000	65484.07
Age	64.88	0	671	63.568
Dis	1452.03	0.19	9223.37	2076.35
Bike	0.1	-	1	0.3
Shower	0.12	-	1	0.33
Renov	0.16	-	1	0.37
BREEM	0.12	-	1	0.32
EPC	0.69	-	1	0.46
Urban	0.49	-	1	0.5
London	0.31	-	1	0.46
Panel B: *t*-test results				
	Bike	Non-Bike	London	Region
Rent	42.65***	28.81	48.41***	16.87
Size	83289.42***	26126.46	48776.01***	24247.38
Age	48.89***	66.65	80.46***	57.97
Dis.	732.56h***	1531.26	348.51***	1942.74
Bike			0.19***	0.06
Shower	0.71***	0.06	0.21***	0.08
Renov	0.38***	0.14	0.27***	0.11
BREEM	0.35***	0.09	0.16***	0.1
EPC	0.63***	0.7	0.72***	0.68
Stars	3.56***	2.92	3.29***	2.85
Urban	0.79***	0.46	0.86***	0.33
No. of Obs.	1237	11232	3838	8631
Panel C: *t*-test results				
	Urban	Suburban		
Rent	36.27***	17.08		
Size	43654.51***	20183.06		
Age	75.01***	54.93		
dis.	758.25***	2131.59		
Bike	0.16***	0.04		
Shower	0.18***	0.07		
Renov	0.23***	0.09		
BREEM	0.15***	0.08		
EPC	0.72***	0.66		
No.	6170	6299		

Note: *** indicates significance at 1%.

Furthermore, we compared the London market, the largest one, with other regions, and the results are reported in Panel B of Table 1. Office rents in London are significantly higher than those outside London. Buildings in London are larger but older than those outside London, and a greater proportion of buildings in London are located closer to the nearest tube/train station compared to those in other regions. Additionally, the proportions of buildings with bike storage (19%) and shower facility (21%) in London are higher than the ones with bike (6%) and shower facility (8%) in other regions. More buildings in London have BREEM certificate (16%) and EPC (72%) than those outside London (BREEM: 10%. EPC: 68%). Moreover, a larger proportion of buildings in London have been renovated since 2000 (20%) and are located in urban areas (86%) compared to those outside London (Renov: 11%; Urban: 33%), indicating significant differences in property attributes across different markets in England.

Among the sampled buildings, 51% are situated in suburban areas. Therefore, we compare the characteristics of properties in urban and suburban area as presented in Panel C. These suburban areas lie on the periphery and relatively new areas, the midway between urban and rural lands (Harris, 2010). Significant differences exist between properties in urban and suburban areas. Urban properties command higher rents, are larger, and tend to be older. Additionally, they are closer to train or tube stations. In contrast, suburban properties are less likely to be renovated and lack amenities such as bike storage, showers, BREEM certification, and EPC ratings.

Test results and discussion

To assess the value of bike storage and shower facility in an office building, we utilise a hedonic model that dissects the value of buildings into their individual building and locational characteristics. Rent represents the economic value that a tenant is willing to pay for a building with a combination of features, with specific attention given to bike storage and shower facility. Table 2 presents the results of the hedonic model regression specified in equation 2.

Table 2 reports the incremental development of the multiple linear regression model across four columns. Each column introduces a new set of variables. In column (1), the two variables of interest, Bike and Shower, are included. In column (2), we incorporate the regions, and in column (3), we add the attributes of the building and their locational characteristics. In column (4), the interaction terms of BREEM with Bike and with Shower are included.

The coefficients of Bike and Shower are statistically significant in all models, indicating that buildings with bike storage and shower facility have rent premiums of 3% and 5%[1] respectively compared to those without them. The finding that showers are significant to office rent is consistent with Robinson et al. (2017) in the U.S. market. However, unlike our results, they did not find a significant relationship between office rent and the provision of bike storage. In column (4), we introduce the interaction terms of BREEM with Bike and Shower to replace BREEM and assess whether BREEM certification and bike storage and shower jointly contribute to rent premiums or their significance is independent of BREEM certification. The coefficient of BikexBREEM is statistically significant, suggesting that bike storage in a building certified with BREEM can further increase the rent premium to 5%[2] compared to its counterparts without BREEM certification. However, the coefficient of ShowerxBREEM is not statistically significant, indicating that the rent premium for shower facility exists independently of BREEM certification.

The results of the control variables align with expectations. The size of the building exhibits a positive association with rent and is statistically significant in models 3 and 4. Age demonstrates a negative relationship with rent, while the square of age shows a positive relationship with rent; both are statistically significant in models 3 and 4. The coefficients of renovation are statistically significant in models 3 and 4, indicating that renovation adds value to the building. Additionally, the coefficient of distance to the closest train/tube station is negative and statistically significant, suggesting that accessibility has a significant impact on rent. The results are consistent with previous studies (Dunse & Jones, 1998; Mills, 1992; Slade, 2000), which found that the conventional features of property significantly impact the prices/rents.

Table 2. Regression test results.

	1	2	3	4
Bike	0.179***	0.083***	0.025***	0.018**
	(0.01)	(0.007)	(0.006)	(0.007)
Shower	0.138***	0.075***	0.048***	0.045***
	(0.009)	(0.006)	(0.006)	(0.006)
LogSize			0.039***	0.007**
			(0.003)	(0.003)
LogAge			−0.097***	−0.118***
			(0.014)	(0.014)
$LogAge^2$			0.043***	0.047***
			(0.005)	(0.005)
Renov			0.044***	0.046***
			(0.004)	(0.004)
Logdis			−0.021***	−0.022***
			(0.004)	(0.004)
BREEM			0.067***	
			(0.005)	
EPC			0.006	0.001
			(0.003)	(0.003)
BikexBREEM				0.045**
				(0.014)
ShowerxBREEM				0.009
				(0.014)
Urban			0.075***	0.075***
			(0.004)	(0.004)
WM		−0.091***	0.004	−0.066
		(0.017)	0.008	(0.015)
SE		0.091***	0.117***	0.117***
		(0.016)	(0.015)	(0.015)
London		0.416***	0.343***	0.341***
		(0.016)	(0.015)	(0.015)
NW		−0.046***	−0.036***	−0.037***
		(0.015)	(0.014)	(0.014)
SW		−0.034***	−0.01	−0.011
		(0.017)	(0.015)	(0.015)
EE		0.036**	0.068***	0.066***
		(0.017)	(0.015)	(0.015)
NE		−0.15***	−0.148***	−0.15***
		(0.018)	(0.016)	(0.016)
YH		−0.105	−0.010	−0.09
		(0.017)	0.009	(0.01)
Cons.	1.290	1.196***	1.001***	0.997***
	(0.003)	(0.016)	(0.026)	(0.026)
Adjusted R^2	0.093	0.614	0.671	0.66
F-value	647.031	1801.593	1344.412	1321.339
No.	12,469	12,469	12,469	12,469

Note: ***, ** and * stand for the significance at 1%, 5% and 10%.

As expected and consistent with the literature, the coefficient of BREEM certification is statistically significant, indicating that buildings with BREEM certification secure a rent premium compared to conventional buildings (see Leskinen et al., 2020 for the review). However, the coefficient of the EPC label is insignificant. The findings of the relationship of EPC and property value are inconclusive. Arguably, the EPC label itself may not have a significant impact, but the ratings within the EPC could significantly affect the property's value (Fuerst et al., 2013; Ke & White, 2024; Parkinson et al., 2013).

People may be more inclined to cycle to work in urban areas than in suburban areas. As indicated in Table 1, 79% of office buildings with bike storage are located in urban

Table 3. Regression tests by location.

	(1). Urban	(2). Suburban	(3). London	(4). Region
Bike	0.018**	0.039***	0.015*	0.045***
	(0.008)	(0.012)	(0.009)	(0.009)
Shower	0.031***	0.06***	0.029***	0.051***
	(0.007)	(0.009)	(0.008)	(0.007)
LogSize	0.009**	−0.002	−0.009	0.01***
	(0.005)	(0.004)	(0.006)	(0.004)
LogAge	−0.101***	−0.083***	−0.062***	−0.116***
	(0.019)	(0.02)	(0.022)	(0.017)
$LogAge^2$	0.055***	0.022***	0.05***	0.037***
	(0.006)	(0.006)	(0.007)	(0.006)
Renov	0.04***	0.035***	0.025***	0.056***
	(0.005)	(0.007)	(0.006)	(0.006)
LogDis	−0.051***	−0.011***	−0.046***	−0.024***
	(0.006)	(0.004)	(0.009)	(0.004)
BREEM	0.071***	0.062***	0.078***	0.065***
	(0.007)	(0.008)	(0.008)	(0.007)
EPC	0.012***	−0.003	0.016***	−0.001
	(0.005)	(0.004)	(0.006)	(0.004)
Urban			0.175***	0.047***
			(0.008)	(0.004)
WM	−0.203***	−0.007		−0.069***
	(0.025)	(0.019)		(0.015)
SE	−0.021	0.179		0.108
	(0.024)	(0.018)		(0.014)
London	0.226***	0.307***		
	(0.023)	(0.019)		
NW	−0.178***	0.03*		−0.041***
	(0.022)	(0.017)		(0.013)
SW	−0.135***	0.045**		−0.015
	(0.024)	(0.019)		(0.015)
EE	−0.078***	0.133***		0.06***
	(0.025)	(0.019)		(0.015)
NE	−0.261***	−0.094***		−0.147***
	(0.025)	(0.022)		(0.016)
YH	−0.161	−0.042		−0.083
	(0.025)	(0.019)		(0.015)
Cons.	1.56***	1.038***	1.273***	1.069***
	(0.709)	(0.033)	(0.037)	(0.029)
Adjusted R^2	0.709	0.335	0.354	0.342
F-value	779.907	226.118	189.893	232.914
No.	6,170	6,299	3,838	8,631

Note: ***, ** and * stand for the significance at 1%, 5% and 10%.

areas compared to 46% in suburban areas. To examine the locational variation in commuting behaviour and the desirability of bike storage and shower facility at the workplace to facilitate cycle-to-work initiatives, we conducted hedonic regression tests by location. The results of these tests are presented in Table 3.

Interestingly, the coefficients of bike storage (0.039) and shower facility (0.06) in suburban areas are higher than the ones in urban areas (0.018 for bike and 0.031 for shower). The coefficients of Bike (0.045) and Shower (0.051) in regions are higher than the ones in London (0.015 for Bike and 0.029 for Shower). These indicate higher rent premiums for buildings with such facilities in suburban areas and regional markets outside London than the ones in urban areas and London. Over the past 20 years, most regions in the U.K. have witnessed an increase in cycling, particularly among those cycling 3–5 times per week (Aldred et al., 2016; National Travel Survey, 2021). For example, before Covid-19, 8 of 9 regions in

2017 and 5 of 9 regions in 2019 saw the increase in cycling according to National Travel Survey (2020). Consequently, the demand for end-of-trip facilities in office spaces within these regions has been on the rise. Another explanation for this phenomenon could be the shortage of supply of buildings with bike storage and shower facility in suburban areas and regions outside London. As shown in Table 1, the number of buildings with bike storage and shower facility in suburban areas and outside London is significantly lower than in urban areas and London. The test results indicate that tenants are more willing to pay rent premiums for the buildings with such attributes, especially in areas where the supply of such facilities is insufficient.

The coefficients of EPC in Table 3 become significant in urban and London markets, but not in suburban and regional markets, indicating that the buildings with EPC in urban areas and London command rent premiums, consistent with some previous studies such as Reichardt et al. (2012) and Holtermans and Kok (2019). Rents in urban areas are significantly higher for the ones in both London and regional markets.

To investigate whether building size or age influences the provision of bike storage and shower facilities, we divided our sample into large and small properties. Large properties exceed the mean size, while small properties fall below it. Additionally, we categorised buildings as old (above the mean age) or young (below the mean age). Our test results are summarised in Table 4: Column 1 corresponds to large properties, Column 2 to small properties, Column 3 to old properties, and Column 4 to young properties. Notably, the coefficients for both bike storage and shower facilities are statistically significant across all models, suggesting that building size and age do not significantly impact the availability of these amenities. Furthermore, the coefficients for other variables are by and large the same as the results reported in Tables 2 and 3.

We now look at the economic value of these facilities based on the analysis above. The cost of installing a 20-space indoor bike rack is estimated to be £8,000. The cost of installing two showers is estimated to be £2,400, according to information disclosed by professional bike rack installation companies on their websites. Based on the average annual rent (£26.58 per SF) and the average size of an office building (31,797 SF), the rent premium per year is estimated to be around £66,773.[3] Although this estimation may not be accurate and could be only an indication, it demonstrates that the economic value of installing bike storage and shower facilities exceeds the installing costs, regardless of the size, age, and location of a building.

Finally, considering that our data are cross-sectional and that the office market is highly heterogeneous, it is likely that the error term does not meet these assumptions. Therefore, we conducted tests for heteroscedasticity using the Breusch-Pagan and White's tests. Table 5 reports the results of the heteroscedasticity tests for the full sample. The Breusch-Pagan test rejects the null hypothesis of homoscedasticity, while the White test cannot reject the null hypothesis of homoscedasticity. As White's test is more general, this still supports adopting robust standard errors in the model estimates presented in Table 2. Separate heteroscedasticity tests were also conducted for different locational rents. The results of the Breusch-Pagan and White's tests are largely similar to the ones presented in Table 5, but are not reported here.

Table 4. Regression test by size and age.

	(1) Large	(2) Small	(3) Old	(4) Young
	(0.039)	(0.036)	(0.161)	(0.026)
Shower	0.038***	0.068***	0.054***	0.035***
	(0.007)	(0.001)	(0.001)	(0.007)
Bike	0.025***	0.026***	0.022**	0.04***
	(0.007)	(0.014)	(0.001)	(0.008)
LogSize	0.047***	0.006	0.017***	0.062***
	(0.007)	(0.007)	(0.005)	(0.004)
LogAge	−0.128***	−0.142***	0.082	0.037
	(0.019)	(0.022)	(0.157)	(0.023)
$LogAge^2$	0.04***	0.055***	0.014	0.046***
	(0.007)	(0.007)	(0.039)	(0.012)
Renev	0.057***	0.054***	0.06***	0.068***
	(0.005)	(0.008)	(0.006)	(0.006)
Logdis	−0.034***	−0.016***	−0.023***	−0.047***
	(0.006)	(0.005)	(0.006)	(0.005)
BREEM	0.089***	0.065***	0.072***	0.08***
	(0.006)	(0.013)	(0.001)	(0.006)
EPC	0.011***	0.002	0.008	0.003
	(0.005)	(0.005)	(0.005)	(0.004)
Urban	0.098***	0.063***	0.104***	0.061***
	(0.005)	(0.005)	(0.006)	(0.005)
WM	0.005	0.02***	0.01	0.023***
	(0.001)	(0.009)	(0.001)	(0.008)
SE	0.197***	0.188***	0.202***	0.181***
	(0.009)	(0.008)	(0.009)	(0.007)
London	0.412***	0.468***	0.481***	0.369***
	(0.008)	(0.008)	(0.008)	(0.008)
NW	0.024***	0.031***	0.033***	0.022***
	(0.009)	(0.008)	(0.009)	(0.008)
SW	0.073***	0.064***	0.077***	0.062***
	(0.001)	(0.009)	(0.011)	(0.008)
EE	0.134***	0.139***	0.126***	0.147***
	(0.001)	(0.001)	(0.012)	(0.008)
NE	−0.07***	−0.07***	−0.068***	−0.079***
	(0.001)	(0.013)	(0.015)	(0.011)
Cons	1.06***	1.147***	0.81***	1.007***
Adjusted R^2	0.681	0.625	0.694	0.657
F-value	744.903	624.955	807.758	704.918
No.	6,025	6,628	6,039	6,614

Note: ***, ** and * stand for the significance at 1%, 5% and 10%.

Table 5. Heteroscedasticity tests for the full sample.

Panel A: Modified Breusch-Pagan Test		
Chi-Square	df	Sig.
0.072	1	0.788
Panel B: White Test		
Chi-Square	df	Sig.
438.921	138	0.001

Conclusions

Cycling is widely recognised as an environmentally friendly and healthy mode of transport. Individuals benefit from cycling as it is not only a healthy but also a cost-effective form of transportation. Additionally, for society at large, cycling offers advantages such as the absence of direct emissions of pollutants, CO2, or noise, along with requiring inexpensive infrastructure and contributing to improvements in public health. Policies and interventions aimed at promoting cycling as a sustainable and active travel option have led to a significant increase in cycling levels over the past three decades across many countries. However, the lack of safe bike storage and shower facilities at destinations has been identified as two factors hindering more people from cycling to work.

This paper investigates whether sustainable features such as bike storage and shower facility in office space can increase rent values using data from existing office buildings in England as of the end of 2021. Despite being desirable features in office buildings, the supply of end-of-trip facilities for cyclist employees is limited. In our sample, only 10% of buildings have bike storage, and 12% of them have shower facility. The proportions of buildings with bike storage (19%) and shower (21%) in London are higher compared to regional markets, where the figures stand at 6% for bike storage and 8% for shower, respectively. The empirical findings strongly indicate that buildings with bike storage and shower facility command rent premiums of 3% and 5%, respectively, compared to those without such green features. Additionally, we observe higher rent premiums for bike storage and shower in regional markets compared to the London market, and higher premiums in suburban markets compared to urban ones.

The primary driver behind the higher rent premiums in these regions is strong demand for and the scarcity of such features in office buildings. Furthermore, we find that bike storage in buildings with BREEM certification secures even higher rent premiums than the non-BREEM certified buildings with bike storage, while the rent premium for shower exists independently of BREEM certification. It is also found that the rent premiums exist irrelevant of the size and age of a building.

These findings hold significant implications for commercial real estate investors, designers, developers, and property managers. They underscore the desirability of these green features among corporate occupiers and highlight tangible financial benefits due to the presence of these facilities. With the U.K. being committed to achieving net-zero emissions by 2050, promoting greener forms of transport, including cycling, is paramount. The findings contribute to the understanding of the drivers of price premiums for buildings. They provide evidence that green features can add value to a building, independent of a green label. This is particularly relevant for buildings that cannot be certified with BREEAM for some reason. Owners of uncertified buildings can also enhance the value of their properties by incorporating such green features. Providing end-of-trip facilities for cyclists not only benefits employees and employers, but also property investors, leading to positive financial outcomes. Ultimately, these initiatives benefit society as a whole.

Notes

1. The coefficient for Bike in Table 2 is 0.025, which translates into (exp(0.025)-1) = 3%. The coefficient for Shower in Table 2 is 0.048, which translates into (exp(0.048)-1) = 5%.
2. The coefficient for BikexBREEM in column 4, Table 2 is 0.045, which translates into (exp (0.045)-1) = 5%.
3. Rent premiums are calculated as (3%*£26.58)+(5%*£26.58)=£2.1 per SF.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Notes on contributor

Qiulin Ke is Associate Professor in Real Estate, the Bartlett School of Planning, University College London. She has BA (honour) in English Literature from Jilin University, China, MSc in Property Investment and Finance from City University UK and PhD in Real Estate Finance in the University of Greenwich UK. she was a research fellow working on the project of transaction cost in residential sector at the University of Greenwich and was a Senior Lecture in Real Estate at Nottingham Trent University for 6 years before she joined UCL in 2012. Qiulin's research interests are real estate market analysis, sustainability and housing market. She has published widely in Journal of Property Investment and Finance, Journal of Real Estate Literature, Property Management, Journal of property Research and Journal of Real Estate Portfolio Management etc.

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