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Factor Analysis of Office Rent in the Kuala Lumpur City Centre Area

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ABSTRACT

The office rental market often relates to good investment opportunities since it draws a lot of capital but comes with a substantial return. It somehow possessed a complicated market structure, and the heterogeneity of office buildings has become a challenge for investors and real estate practitioners to analyse office rentals data. This research seeks to analyse an office rental factor analysis based on data evidence from the Kuala Lumpur city centre, using two different approaches: Manual SPSS and AutoModel RapidMiner. Quantitative data, obtained through secondary data of office rental transactions, consist of a data set that includes 542 office rental transactions from 2015 to 2021. The results from the two different approaches were significantly related by studying the correlation value achieved through the AutoModel and Spearman rank correlation. The three determinants, namely green certificates, building appearance and design, and amenities and in-house services, can be identified as strong determinants. The research findings also provide support for the use of both manual and automated approaches in factor analysis and suggest that they can be used interchangeably to achieve similar results. This research allowed for a more comprehensive understanding of the office rental market in Kuala Lumpur, and provided real estate practitioners with useful insights into factors that influence office rental prices.

1. Introduction

Real estate has consistently garnered high demand worldwide, and it has become a vital industry for the economy, with the potential to influence stock market fluctuations and cause disruptive economic events Cajian & Marcelo [1]. The industry can be broadly classified into residential, commercial, and industrial real estate, and each use's performance can vary considerably, even within the same use Rayyan *et al.,* [2]. In commercial real estate, the office space market is more synchronised in terms of exposure to macro-effects and performance, and its heterogeneity makes it more challenging to analyse. Although property prices may be determined by the market, they may

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not always equate to the property's actual valuation Chaphalkar *et al.,* [3]. The market is also known to offer good investment opportunities, as it attracts a significant amount of capital with substantial returns Le *et al.*, [4]. Despite its well-established investment status, the real estate industry's market structure is complex, with no central marketplace and the individuality of each building. Investors typically base their decision to invest in office properties on the rental rate of the building to secure guaranteed capital and cash flows. Thus, their reliance on presumptions of office market dynamics has become a key value driver in accurately anticipating future profitability and income projections Kołodziejczyk *et al.,* [5].

Understanding the market requires analysing the factors that determine office rental rates, which influence their fluctuation. There have been several studies on office rental determinants in recent years Ozus & Evran [6]. Previous research has indicated that practitioners often rely on demand and sensitivity analyses when setting rental rates, whereas academics focus more on the significance of these determinants and their impact on predicting market trends Wang & Buyang [7]. While the determinants of office rental rates may vary across studies, this paper has classified them into five primary categories: physical, locational, lease details, and macroeconomic factors. Previous research highlights the importance of considering these determinants when studying office rental rates, and a proper methodology should be used to examine their relationship.

In any real estate market, it is widely known that prices and rentals can vary significantly based on location Ozus & Evran [6]. Location effects, which are unique and observable characteristics of an area, also play a significant role in determining property prices and rentals Öven & Pekdemir [8]. This is because location is a dynamic phenomenon influenced by various factors that retail investors have come to recognize Čeh *et al.,* [9]. In the European office market, locational diversification is crucial, as it can be linked to factors such as environmental regulations, changing tenant preferences, and labor accessibility Kok & Jennen [10], all of which can significantly impact the rental value of office buildings.

Macroeconomics is a branch of economics that analyzes an economy's overall performance, structure, behavior, and decision-making, with a focus on the overall performance of the economy. Several macroeconomic determinants such as GDP, unemployment, income level, and stock market performance have been identified as key factors affecting office rentals on the demand side Ng & Higgins [11]. Employment in the office sector has been identified as a critical factor in the variations of office rentals, with a positive reaction to a rise in employment, especially when the vacancy rate is lower than the long-term average Brounen & Jennen [12]. Inflation has also been found to be related to the performance of the commercial real estate market, with rentals historically rising when inflation causes prices and wages to rise. As commercial real estate values are frequently based on net income, rentals and expenses should increase or rise in lockstep with inflation. In European studies, rental values are determined based on the Gross Domestic Product (GDP) Giussani *et al.,* [13]. However, the effect of GDP on the office rental market in Malaysia has yet to be embraced. A study on the macroeconomic determinants of office rental for major cities in Southeast Asian Cities (including Kuala Lumpur) by Wei Chin [14] suggests that GDP is not a strong driver. The author claims that in European studies, GDP contributes the most to determining office rental.

The quality, prestige, environmental factors, and internal services are physical characteristics that impact office rental rates Ozus & Evran [6]. The age of the building also affects office rental rates, with newer buildings commanding higher rental rates Wang & Buyang [7]. These factors influence property prices and real estate investment returns Irjet *et al.,* [15]. Building design is an important consideration for potential tenants, but developers have traditionally focused on location rather than design Antusias *et al.,* [16]. While a good building design may increase rental rates, it is not always considered a significant determinant Antusias *et al.,* [16]. Amenities such as landscaped gardens,

retail services, health clubs, and restaurants also influence office rental rates Ho *et al.,* [17]. Convenient access to amenities is valued by tenants and can command a premium in rental rates Fuerst [18].

The most used lease characteristics in office market literature are the leasing period and rental area size Ozus & Evran [6]. A lease agreement specifies the terms under which a lessor rents out a property to a lessee, including the rentable area, tenancy duration, and service charge Ke & White [19]. When calculating office building rental rates, the rentable area and usable space must be determined to arrive at an exact rental rate Van Der Voordt [20]. Proper utilisation of office space can greatly reduce costs, thus affecting rental rates Van Der Voordt [20]. The leasing period or tenancy duration is another factor that can affect rental rates, as tenants with longer-term leases may be offered lower rents to minimise turnover costs associated with financial management involving the commercial property and associated investors Wang & Buyang [7]. Therefore, the length of the lease can be used as a criterion for determining rental rates.

The topic of environmental sustainability and sustainable architecture, particularly the development of green buildings, has become a significant concern globally Abdul *et al.,* [21]. The Malaysian government has implemented policies, such as the Green Building Index (GBI) Certificates, to promote sustainability in office building development and support business operations Wang & Buyang [7]. In addition to green certification, certain office buildings in Malaysia have been awarded the Multimedia Super Corridor (MSC) Status for their technological advancements. This designation is provided by the Malaysian government through the Multimedia Development Corporation (MDeC) to enterprises that carry out ICT activities in the MSC and meet strict specifications for world-class infrastructure and cutting-edge technologies. The impact of certifications, such as GBI and MSC, on office rental rates is not yet fully understood, but Wang & Buyang [7] acknowledges their significance as determinants in the office rental market in Kuala Lumpur. Figure 1 illustrates the conceptual framework of office rental determinants based on previous literature.

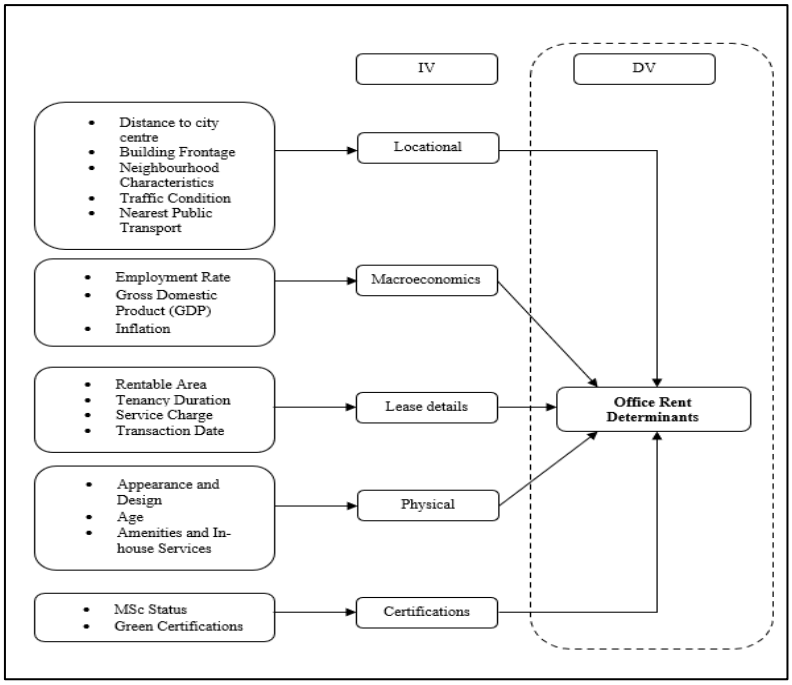

Fig. 1. Conceptual framework of office rent determinants

2. Methodology

2.1 Factor Analyses

The method of factor analysis is used to reduce the number of variables into a smaller set of factors by converting all variables into a common score while removing as much common variance as possible Mohd & Bee [22]. This statistical procedure is widely used in fields such as information systems, social sciences, education, and psychology Taherdoost *et al.,* [23]. There are two main categories of factor analysis: Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). In this study, we focus on the application of exploratory factor analysis, which prioritizes the assessment of multicollinearity among correlated factors. A popular statistical technique used in EFA involves experimenting with the correlation matrix to determine the relationships between variables Taherdoost *et al.,* [23]. We have utilized this approach to fully utilize the conceptual framework developed in Figure 1. The factors from the conceptual framework were interpreted in the correlation matrix using correlation as the primary technique for this study. Figure 2 presents the steps of the EFA used in this study.

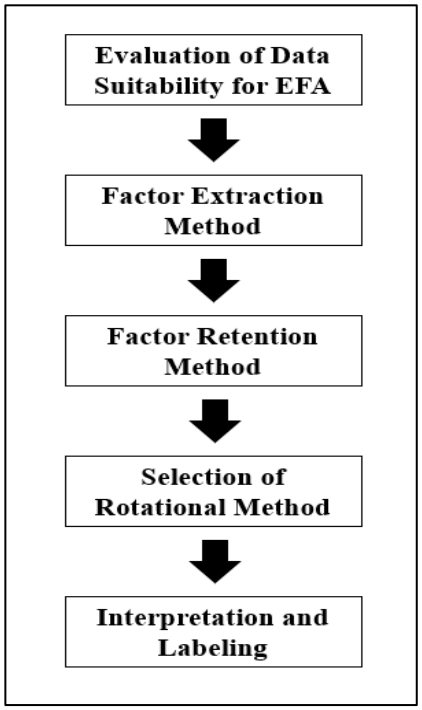

Fig. 2. Exploratory factor analyses steps

2.2 Spearman Rank Correlation

The rationale for using Spearman Correlation in this study stems from the small and unnormalized distribution of the dataset based on Shapiro Wilk test. The data set used in this study comprised only 538 office rental transactions obtained from the Valuation and Property Services Department. Spearman's Rank Correlation Coefficient, denoted by ρ or "rs," is typically used with ordinal data and is not restricted to continuous variables. Its value ranges from -1 to +1, indicating the absence of any relationship (ρ = 0) or a perfect monotonic relationship (ρ = -1 or +1) Schober & Schwarte [24]. The strength levels of the Spearman's correlation coefficients used in this study are presented in Table 1.

Table 1.
Interpretation of correlation coefficient

Correlation coefficient		Strength level
1	-1	Perfect
(0.6 to 0.9)	(-0.6 to -0.9)	Strong
0.5	-0.5	Moderate
(0.4 to 0.1)	(-0.4 to -0.1)	Weak
0	0	No correlation

The Statistical Package for the Social Sciences (SPSS) was employed as a tool for the analysis. Therefore, the study provides a statistical correlation between office rental and its influencing factors.

2.3 AutoModel

AutoModel not only supports factor analysis but also provides automation analysis for machine learning predictions. It allows users to easily and rapidly analyze datasets, visualize the results, and explore different statistical models Roslan *et al.,* [25]. AutoModel offers an intuitive interface that guides users through the entire analysis process, from data preparation to model selection and evaluation Adnan *et al.,* [26]. This powerful tool is designed to help users save time and effort in performing complex data analyses, especially for those who are not familiar with programming or statistical software Roslan *et al.,* [25]. With AutoModel, users can easily generate accurate predictions, gain insights from their data, and make informed decisions Abdullah *et al.,* [27]. Figure 3 depicts the basic pre-processing in AutoModel used in this study.

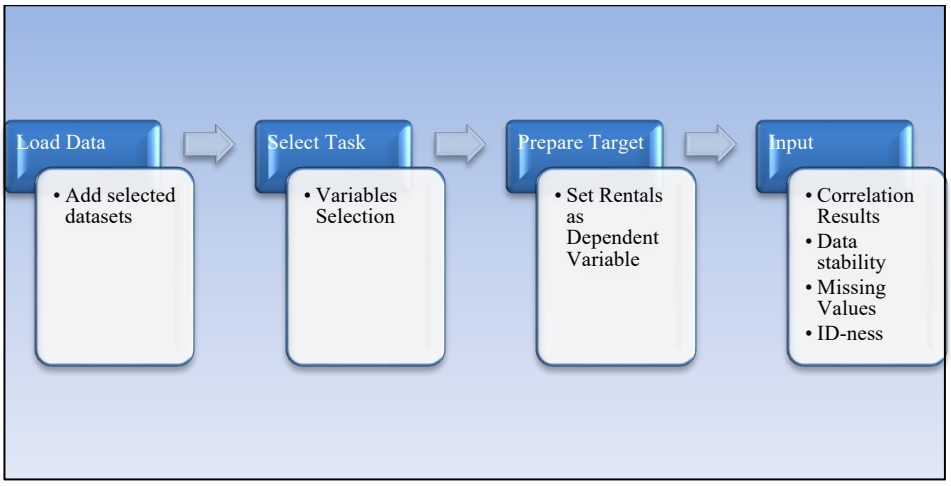

Fig. 3. Factor analysis steps in AutoModel

AutoModel provides a detailed analysis of the correlation, ID-ness, and stability of the factors obtained from the factor analysis. AutoModel uses correlation matrix to identify correlated factors and perform factor analysis, as well as to evaluate the strength of the correlations between the factors and the target variable. The ID-ness analysis determines whether the factors are unique or redundant, which is crucial in reducing complexity and increasing interpretability. AutoModel calculates ID-ness using the uniqueness score for each factor, which is calculated by dividing the sum of squared factor loadings by the sum of squared factor loadings plus the sum of squared residual variances. Factors with high uniqueness scores indicate that they are more unique and represent a

more distinct construct. On the other hand, factors with low uniqueness scores indicate that they may be less distinct and may be a combination of multiple constructs.

The stability analysis in AutoModel helps ensure the robustness of the model by assessing the consistency of the factor structure across different data subsets. This analysis involves using random sampling to split the data into multiple subsets and then performing factor analysis on each subset. The resulting factor structures are compared to evaluate the stability of the model. This approach helps detect any unstable factors that may have arisen due to sampling variability or other random factors. By ensuring the stability of the factor structure, AutoModel can provide more reliable and accurate results for the user.

In addition to correlation, ID-ness, and stability analysis, AutoModel in RapidMiner also provides the option to consider missing and text-ness as additional attributes in the factor analysis. Missing values are common in real-world datasets and can affect the results of the analysis. AutoModel allows for the handling of missing values through imputation methods. Text-ness refers to the presence of textual data in the dataset, which requires special handling in the analysis. AutoModel offers techniques for text preprocessing and feature extraction to address this issue. By considering missing and text-ness as attributes, AutoModel can provide a more comprehensive and accurate factor analysis of the dataset. Figure 4 depicts the interface of factor analysis interface of AutoModel in RapidMiner.

3. Results

The results of the Spearman correlation analysis from SPSS were presented first, followed by the results of the AutoModel RapidMiner factor analysis. The Spearman correlation analysis was conducted to determine the statistical correlation between the factors affecting office rental, while the AutoModel factor analysis provided additional insights into the underlying factors driving the rental prices. By combining the results of both analyses, a more comprehensive understanding of the factors influencing office rental prices can be obtained.

3.1 Spearman Correlation

Table 2 presents the correlation results obtained from the Spearman correlation analysis. The factors are grouped into five main categories, namely Certifications, Physical, Locational, Lease details, and Macroeconomics. Each factor has its specific determinants.

The Spearman correlation analysis revealed that most of the determinants had unexpected values. The highest correlation was found between amenities and in-house services, which had a strong positive relation with office rental (Rs = 0.732). This suggests that the availability of various services, such as banks, retail services, health clubs, and food outlets, contribute to higher rental rates for a specific building. This finding is consistent with previous research that found that services provided by an elite office building contribute to higher rental rates where the occupants are usually willing to pay higher rentals. From the physical group, other factors of from building appearance and design has a moderate positive correlation value (Rs=0.569) towards office rental, whereas building age and frontage have a weak negative correlation value (Rs=-0.043, Rs=0.072).

Table 2.
Spearman rank results

Group	Determinants	Correlation
Certifications	MSc status	0.254
	Green Certificate	0.512
Physical	Building appearance and design	0.569
	Building age	-0.043
	Amenities and in-house services	0.732
	Building frontage	0.072
Locational	Distance to city centre	-0.052
	Neighbourhood characteristics	0.023
	Traffic condition	-0.009
	Nearest public transport	0.103
Lease details	Tenancy duration	-0.067
	Service charge	0.267
	Transaction date	0.212
	Rentable area	0.557
Macroeconomics	Inflation	0.026
	GDP	0.046
	Employment rate	0.080

The correlation analysis also found that green certification achieved a moderate correlation with rental rates (Rs=0.512). The adaptation of green technologies can be associated with higher valuation for buildings since it shows good correlation values as depicted. But, the Msc status from the certification group only indicates a small effect (Rs=0.254) on the valuation.

The Rs=0.557 between rentable area and office rental suggests a moderately strong positive correlation between these two variables. It implies that larger office spaces are likely to command higher rents. It can be observed that only the rentable area from the lease details factor shows a moderate correlation with office rentals, other factors such as tenancy duration (Rs = -0.067), service charge (Rs=0.267) and transaction date (Rs=0.212) show a low correlation value towards office rental.

The overall locational determinants show a weak correlation value towards office rental. The distance to the city centre had a negative linear relation with office rentals (Rs=-0.052), which means that the shorter the distance of the building to the city centre, the higher the rentals. The public transport and neighbourhood characteristics also demonstrate a weak correlation. The buildings located in areas with lower traffic conditions tend to have higher rental rates, while buildings located in areas with higher traffic conditions tend to have lower rental rates. However, the correlation is weak (Rs=-0.009), meaning that traffic conditions alone may not be the only factor determining the rental rates. Similarly, other determinants showed a negative linear relation between office rental, such as from the tenancy duration (Rs=-0.067) and building age (Rs = -0.043). This suggests that as the length of tenancy duration increases, the rental value of the office tends to decrease very slightly. Similarly, as the age of the building increases, the rental value of the office tends to decrease very slightly.

Inflation (Rs = 0.026), GDP (Rs = 0.046) and employment rate (Rs=0.080) from macroeconomics group also tended to react toward office rentals but with weak correlations as depicted.

3.2 AutoModel

The factor analysis results using AutoModel are presented in Table 3, with the determinants grouped into five factor groups, as in the Spearman correlation analysis. The value of correlation is expressed as a percentage because it represents the strength of the linear relationship between two

variables in terms of the proportion of variation in one variable that can be explained by the variation in the other variable. In this study, missing values were not present in the dataset, thus the AutoModel was not required to address this attribute of factor analysis. Additionally, since all text data had been pre-processed and coded into numerical data, the text-ness attribute of factor analysis was not a concern.

Table 3.
AutoModel results

Group	Determinants	Correlation	ID-ness	Stability
Certifications	MSc status	1.92%	0.29%	79.22%
	Green Certificate	34.44%	0.72%	64.79%
Physical	Building appearance and design	21.51%	1.3%	41.85%
	Building age	0.10%	5.92%	11.54%
	Amenities and in-house services	40%	1.3%	32.76%
	Building frontage	0.2%	0.14%	100%
Locational	Distance to city centre	0.41%	0.43%	54.98%
	Neighbourhood characteristics	0.19%	0.87%	45.17%
	Traffic condition	0.19%	0.43%	66.09%
	Nearest public transport	0.02%	0.43%	85.28%
Lease details	Tenancy duration	0.26%	0.58%	36.94%
	Service charge	0.39%	0.295	69.99%
	Transaction date	0.62%	1.01%	35.64%
	Rentable area	10.68%	-	1.88%
Macroeconomics	Inflation	0.15%	-	36.22%
	GDP	0.01%	-	99.86%
	Employment rate	0.56%	-	99.86%

AutoModel indicates amenities and in-house services under physical determinants acquire the highest correlation percentage with 40%, high ID-ness of 0.72% and good stability of 64.79%. Building appearance and design, which falls under the physical group, obtained a correlation percentage of 21.51%. However, its ID-ness was only 1.3%, indicating that this determinant did not have a strong unique influence on the overall model. Moreover, its stability was only 41.85%, which suggests that the correlation between these determinant and rental prices might vary across different samples. The building age and building frontage have a very low correlation percentage and ID-ness, suggesting that these determinants have little impact on office rental prices. However, the analysis shows that building frontage has 100% stability, which implies that this determinant consistently contributes the same value to the overall analysis.

AutoModel revealed that green certificates have a relatively good correlation percentage of 34.44%, which ranked it as the second highest correlated determinant. Although its ID-ness is relatively low at 0.72%, the stability of the correlation is good at 64.79%. This suggests that the presence of green certificates in a building can have a positive impact on the rental price and may be a valuable factor to consider in the rental market. Msc status has a relatively weak correlation with rental prices, as it only gained a correlation percentage of 1.92%. Moreover, the low ID-ness of 0.29% suggests that there is little variation in Msc status among the sample properties. Nonetheless, the good stability of 79.22% indicates that the relationship between Msc status and rental prices remains consistent over time.

Under the locational group, the determinants in this category exhibit significantly low correlation percentages with the rental prices. However, the distance to city centre is relatively more important as it shows a slightly higher correlation percentage of 0.41%. The ID-ness value for three determinants within this group is only 0.43, whereas the neighbourhood characteristics have an ID-

ness of 0.87%. It is interesting to note that traffic condition and public transport show good stability 66.09% and 85.28% respectively, indicating a consistent relationship between these determinants and rental prices over time.

The lease details group has three determinants with a correlation of less than 1%, while only the rentable area shows a slightly higher correlation percentage of 10.68%. However, the rentable area does not have any ID-ness value and only shows a stability of 1.88%, suggesting that it may not have a significant impact on rental prices. The service charge shows good stability with a percentage of 69.99%, suggesting a consistent relationship with rental prices over time.

The determinants under the macroeconomics group show low correlation percentages ranging from 0.01% to 0.5%, and none of them have any ID-ness. However, GDP and employment rate demonstrate good stability at 99.86%.

3.3 Results Comparison

The correlation values obtained through the two different approaches utilized in this study, namely Spearman rank and AutoModel were found to be strongly related. The highest correlation percentage achieved through the AutoModel for building rental determinants was amenities and in-house services, which was consistent with the results obtained through the Spearman correlation analysis. The green certifications determinant also showed a high correlation percentage in AutoModel, which was in line with the results obtained through the Spearman analysis. However, when considering the stability provided by AutoModel, it can be observed that green certificates are more stable compared to amenities and in-house service. Based on their correlation scores, three determinants, namely green certificates, building appearance and design, and amenities and in-house services, can be identified as strong determinants. Table 4 presents the correlation scores of the three most important determinant group from the Spearman and AutoModel.

Table 4.
Correlation results comparison

Determinants	Spearman Correlation	AutoModel	Stability
Green certificate	0.512	0.34	64.79%
Building appearance and design	0.569	0.21	41.85%
Amenities and in-house services	0.732	0.40	32.76%

The Spearman correlation coefficient and the correlation coefficient from AutoModel in RapidMiner are two different measures of correlation that are calculated in slightly different ways. The Spearman correlation coefficient is a non-parametric measure of the strength and direction of the relationship between two variables. On the other hand, the correlation coefficient from AutoModel in RapidMiner is calculated using a linear regression model, which estimates the strength and direction of the linear relationship between two variables based on the actual values.

Thus, comparing the two results may not be appropriate. Nevertheless, it is worth noting that although the correlation strength from AutoModel may appear weaker, the inclusion of stability information has reinforced the argument that the three determinants are highly significant.

4. Conclusions

The study identified several determinants that significantly affect office rental prices, including green certificates, building appearance and design, and amenities and in-house services. These determinants exhibit high correlation percentages and good stability over time, indicating that they

have a consistent and significant impact on rental prices. The study employed two different approaches, Spearman rank and AutoModel, to analyse the determinants of office rental prices. The results obtained from these two approaches were found to be significantly related, indicating the validity and reliability of the findings. These findings can be used to suggest that landlords and property managers should focus on improving the green certification, appearance and design of the building, and amenities and in-house services in order to attract tenants and maximize rental prices. One limitation of this study is the sample size, as it only included a limited number of office properties in a specific geographic area. Future studies could expand the sample size and include properties from different locations to obtain a more comprehensive analysis. Additionally, other determinants, such as accessibility and parking, could be included in the analysis to further understand their impact on rental prices.

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