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Depreciation between Conventional and Green Office Buildings

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Abstract

The principal aims of this paper are; (1) to determine the rate of depreciation for certified green and conventional purpose-built office (PBO) and; (2) to assess the relationship between building categories and green building classifications toward influencing the rental depreciation of PBO buildings. Using cross sectional survey of twenty-seven buildings in Golden Triangle area of Kuala Lumpur, the data collected were analysed using Frequency and Descriptive statistics to establish the rate of depreciation for green and conventional PBO buildings. Furthermore, the correlation and regression techniques were used to assess the significance of building categories and classifications in influencing the rental depreciation of PBO buildings. This study successfully identifies the average rate of depreciation within the dataset, with 46.77 percent. In comparison of average depreciation rate between green office buildings and conventional, the rate was observed higher in conventional class as to contrast with green class PBO buildings. Results from the correlation analysis explain the age, building categories and classifications were strongly correlated to the rental depreciation. Lastly, regression results evidenced the building categories and classifications significantly predict the rental depreciation model in 2014.

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1. Background of Research

Studies on the depreciation and obsolescence to property has long been discussed and debated in the real estate body of knowledge. Depreciation factors and its impacts on real estate were extensively investigated by early
scholars (Baum, 1991; Baum, 1997; CALUS, 1986; Barras and Clark, 1996; Jones Lang Wootton, 1986). Earlier work by Baum (1991) establishes the components of depreciation including property obsolescence and deterioration.

The studies on depreciation impact to commercial property has gained much attention during the year 1986 to 1999 as several earlier scholars have embarked on the study to quantify the depreciation impact on commercial property. Jones Lang Wootton (1986) produced an empirical study on the substantial impact of market state, and age on Rental Obsolescence Rate (ROR) of commercial and industrial buildings during 1980-85 in UK. While other scholars focused on investigating the impact of depreciation, rather than the factors influencing rental. Using cross-sectional and longitudinal survey of commercial and industrial buildings in UK, Baum (1991) confirmed that building qualities (external appearance, internal specification and configuration) were the most significant factors in explaining building depreciation, rather than the age. Again, Baum (1997) reconfirmed the same findings by conducting an updated investigation on office buildings in the city of London. It can be argued that the foundation for property depreciation studies of commercial office buildings in the late 1980’s until 2000 are confined to the features and characteristics of commercial office buildings at that time. With increasing environmental and energy efficiency awareness among the office users and occupiers, green office buildings have become the trend in recent times.

In Malaysia, the development of Green commercial buildings (GBI-building) has become hype over the last few years. Countless researches have been performed either to study the financial, materials and social performance of green buildings. Green building was found to be energy efficient (Paumgartten, 2003; Roper & Beard, 2006; Myers, et al., 2007); environmentally friendly (Myers et al., 2007) and; able to increase user productivity and reduce health related illness from poor indoor air quality (Paumgartten, 2003; Roper & Beard, 2006). With these benefits and advantages green office buildings possess, depreciation to conventional office buildings may originate from the relative disadvantage in relation to green office buildings which are more energy efficient. This study tries to investigate the following issues of quantifying the impacts of green buildings towards depreciation of conventional buildings in Malaysia. Limited researches in understanding the phenomena of green related depreciation studies in Malaysia ignite the novelty for the researcher in embarking this study.

There are five (5) sections structured in this paper. The initial chapter describes the background of research for the topic under study. While Section two (2) deals with the theoretical literature including the factors and methodology employed by previous research in estimating depreciation and green related depreciation. Section three (3) discusses on the design and methodology employed to achieve the objectives. Section four (4) explains the results generated from the analysis of descriptive and multiple regression analysis and its’ justification to interpret the objectives. Final Section concludes the overall achievement of this study.

2. Literature Review

This section covers the theoretical background of the study. It discusses the definition of depreciation, overall causes and factors of property depreciation, while simultaneously introducing the new cause of depreciation to conventional office buildings; the green building features and certification. This section also summarises the imperative factors that lead to property depreciation so as to develop the operational framework of collection and analysis of data.

2.1. Depreciation

Depreciation in general term is defined as an asset value reduction over time as a result of wear and tear (Oxford Online Dictionary, 2015). In real estate body of knowledge, the definition are suitably defined from the earlier study conducted by Baum (1991) where he defined depreciation as a loss in the ‘real existing use value of property’ due to obsolescence. Obsolescence as been distinguished by Hoesli & Macgregor (2000) is a decline of the property utility without being influenced by physical usage, environmental factor or passage of time. As part of the elements that need to be considered in real estate valuation and appraisal, property depreciation theory suggests the negative notion it has on the market value and rental performance of property. The causes of this phenomena were largely due to the impact of physical deterioration (Baum, 1991); while Khalid (1992) further broadens the Baum (1991) perspectives into functional and technological obsolescence. Functional obsolescence is associated with the inability
of current property state to accommodate technological change demanded by occupiers (Dixon, 1999) or to function for its intended use or designed (Reilly, 2012). It is centred on the whole building and in the form of outdated IT technology or defective layout. Technological obsolescence, on the other hand is more related to the component of the building itself such as an ineffective mechanical and electrical (M&E) systems, and facilities.

Depreciation is well known to have impacted the rental and market value of commercial buildings. Earlier study from Baum (1991) using cross section year of 1986, measured the depreciation rate to commercial offices in London. It was estimated that commercial depreciation rate recorded a 1.1 percent per annum. CALUS (1986) nevertheless estimated higher depreciation than Baum (1991) which was at 3.0 percent per annum using cross section year of 1985. Barras and Clark (1996) quantitatively measured the depreciation rate for offices in 1980, 1989 and 1993. It was observed that 1980 depreciation rate for offices was similar to 1993 (1.2 percent), and the highest depreciation was recorded in 1989 with 1.5 percent per annum. An updated study of depreciation rate using 1996 as the cross section year by Baum (1997) found that the rate of depreciation was increased as to compared with 1986 depreciation with the increment of 1.1% per annum. In regards to the local context, Khalid (1992) and Yusof (2000) had initiated the studies of depreciation rate for commercial buildings in Kuala Lumpur. Using data on rental, both studies were able to measure the depreciation rate. Khalid (1992) found that the depreciation rate in Central Kuala Lumpur was at 2.4 percent per annum. A study by Yusof (2000) further distinguished the offices into three (3) types which are the traditional, transitional and modern offices and that the depreciation rate varies in accordance to these three types. It was observed (using 1996 and 1986 basis of cross section years) that traditional office possesses higher depreciation rate (23.8 percent) as to compare with other types of offices. While the modern office, recorded the lowest depreciation rate with 7.0 percent in Yusof (2000) dataset. Yusof (2000) studies initially evidenced the variations of depreciation rates across different types of offices in the Kuala Lumpur property market.

Previous studies provide the general understanding on how the depreciation will hamper the investment potential of offices. The offices generally obtained their return through the tenant rental and capital value appreciation. High depreciation rate will cause the offices to lose tenant, thus increasing the vacancy rate. Directly, the owner will suffer reduction in rental income. The office will lose its appeal to prospective tenants resulting from depreciation and obsolescence.

Table 1. Summary of office rental depreciation from previous research.

| No. | Author          | Location                          | Cross-section year | Annual Depreciation rate (%) |
|-----|-----------------|-----------------------------------|--------------------|------------------------------|
| 1.  | Yusof (2000)    | Central Kuala Lumpur Offices:     | 1996 & 1998        | Traditional - 23.8          |
|     |                 | - Traditional                     |                    | Transitional - 17.5         |
|     |                 | - Transitional                    |                    | Modern - 7.0                |
| 2.  | Khalid (1992)   | Central Kuala Lumpur Offices      | 1991               | 2.4                          |
| 3.  | Baum (1991)     | City of London Offices            | 1986               | 1.1                          |
| 4.  | Baum (1997)     | City of London Offices            | 1996               | 2.2                          |
| 5.  | Barras and Clark (1996) | City of London Offices | 1980 | 1.2                          |
|     |                 |                                   | 1989               | 1.5                          |
|     |                 |                                   | 1993               | 1.2                          |
| 6.  | CALUS (1986)    | Britain                           | 1985               | 3.0                          |

2.2. Relationship between green certification and rental value or capital value

Previous studies on the impact of green certification towards rental value or capital price can become a fundamental evidence or basis in determining the impact of depreciation to certified green buildings. Most of the current literatures deal with the positive impact of Green Building certification towards rental or market price performance. As such, the results obtained from previous studies can indicate how well the green certification impacted the performance of office buildings that can further be related to the depreciation and green certification issues in this study.

Several studies acknowledged the impact of green certification towards rental of property. It can be observed in the studies from Harrison & Seiler, 2011; Eichholtzet al., 2011; Wiley et al., 2010; Miller et al., 2008. Harrison & Seiler (2011) conducted a study on office buildings in the US has found out that Energy Star and LEED certified
buildings command an average rental premium of almost 6 percent from the non-certified buildings in the year of study. Using Ordinary Least Square method, the results suggested that there was a significant relationship between green certification and rental premium for office buildings. Eichholtz et al. (2011) study also supports the results obtained in Harrison & Seiler (2011). Using rental and sales data as dependant variables, the study successfully derived a conclusion that a certified building is better than non-certified. Certified green building was able to achieve higher rental rates from non-certified of about 3 percent. In the perspective of pricing, the certified green building commands 16 percent higher pricing than the non-certified in the open market. Furthermore, LEED rating was able to bring positive impact to sales price with 9.94 percent per square foot while Energy Star Rating gives 5.76% increased to the sale price (Miller et al., 2008). Statistical results using ordinary least square further suggests that green building rating brings impact to the rental market judging from high coefficient of Energy Star (29.71) when being regressed with the rental rate and price of office buildings (Wiley et al., 2010). Conclusively, these studies provide solid empirical evidence on the positive impact of green labelled or certification to the office market rental and prices. It shows the green certification was positively correlated to the rental and sales price of the office buildings. Nevertheless, studies on the impact of the lack of green certification on the depreciation rate of office buildings has been lacking due to the fact that most researchers are focusing on the positive views of green certification to the rental or price performance. Thus, this paper tries to investigate the relationship between green certification towards depreciation of office buildings in the case study area. The questions that need to be asked is whether the certification of green buildings helps in reducing the depreciation for office buildings or otherwise. To answer this question, the study will assesses the rate of rental depreciation between certified green office and conventional buildings using descriptive and cross-sectional approach.

3. Design and Method

This section presents the operational framework to quantify the depreciation rate for both conventional and green Purpose-Built Office Buildings (PBO). The building samples and data analysis techniques are also being discussed.

3.1 Sample characteristics

Fifty-four purposed built office buildings located in the Kuala Lumpur area have been selected from the Property Market Report 2014 and the Green Buildings Index (GBI) list. The PBO buildings were selected based on the criteria set by researcher which are within the Golden Triangle area, and; the usage is dominantly for office with 75% of the net lettable area (NLA) are for office use. Nevertheless, initial analysis showed the data contains outliers that may influence the results of the analysis. As a result, the outliers with rental above and below the mean rental value were removed. In addition, refurbished buildings were also removed from the dataset to ensure the building condition match to their age. The final dataset produces seventeen conventional and ten Green buildings. In order to mitigate the influence of economic depreciation i.e. location factor on the rental data, the PBO buildings subjected to this study were only selected from Golden Triangle (GT) area of Kuala Lumpur.

3.1 Data

Using secondary rental data and relevant features of Purpose Built Office (PBO) collected from JPPH secondary data and further validated by estate agents, the data was prepared to be analysed. In this context, the variables were divided into two dependant and independent variables. Dependant variable will consist of the average rental value
data. It is because the rental value was largely used as a proxy for depreciation in various studies (Yusof, 2000; CALUS, 1986; Jones Lang Wootton, 1986; Baum, 1997; Barras and Clark, 1996, Khalid, 1992) or as a determinant to green buildings investment performance (Millet et al., 2008; Wiley et al., 2010; Harrison & Seiler, 2011; Eicholtz et al., 2011; Fuerst & McAllister, 2011). The average rental data for 2014 of the purpose-built office were used to estimate the depreciation rate for green buildings and non green buildings.

3.2. Data analysis

For the purpose of achieving the objectives of the studies, the depreciation rate was analysed using Cross Sectional approach, where only one (1) base year was adopted which is 2014. The data collected was analysed using Stepwise Multiple Regression Analysis (MRA) technique on Statistical Packaging System (SPSS) version 22. This method was adopted due to its suitability in explaining the relationship and measures the significant level between dependant and independent variables within the depreciation model. In addition, this model has been used in most of the previous studies of property depreciation and green building performance. The derivation of depreciation rate for PBO buildings under study was originally calculated using the rental depreciation formula where:

\[
\text{Rental Depreciation (\%) = } \frac{\text{Prime Rent} - \text{Office Rent}}{\text{Prime Rent}} \times 100\%
\] (1)

This rental depreciation technique has been used by Yusof (2000) to establish the rate of depreciation in 1996 and 1998 for forty-nine office buildings. For the purpose of this study, the highest average rental achieved in 2014 was RM10.50 and it was selected as the benchmarks for the prime rent (PMR, 2014). The depreciation rate for 2014 will then be used as a dependant variable in regression analysis.

3.3.1 Hedonic price technique

To assess the multiple effects of independent variables on the rental depreciation for Purpose Built Office, a multiple regression analysis was executed. Hedonic rental method is suitably adopted as it provides solution in analysing property rental by representing a set of property attributes in a single measure of office rental. The hedonic model in this study will pin-point the implicit price of each characteristic so as to relate to the depreciation of purpose built office. From the literature, the depreciation of property normally arises from physical deterioration, building obsolescence and site obsolescence. The selected attributes that represent the property depreciation causes are regressed with the rental value of Purpose Built office. The hedonic technique will estimate the importance of variables in dictating the depreciation rate of green or conventional PBO buildings in Kuala Lumpur. The hedonic model used in this study is in the following functional form:

\[\text{Dep.Rental}_{2014} = b_0 + \text{Fac}_1X_{1t} + \text{Fac}_2X_{2t} + \text{Fac}_3X_{3t} + \ldots + \text{Fac}_nX_{nt} + \varepsilon_{it}\] (2)

The functional relationship between rental depreciation and building characteristics i.e. green building features explanatory variables is shown in Table 2.

| No. | Main variable       | Sub-variable                        |
|-----|---------------------|-------------------------------------|
| 1.  | Building Category   | Green Building, Non Green Building   |
| 2.  | GBI Classification  | No certification, Platinum, Gold, Silver, Certified |

4. Empirical Results and Discussions

Result and discussions of the analysis are presented in this section. It is divided into the results obtained from Descriptive analysis and the Multiple Regression Analysis.
4.1. Results from frequency analysis

Table 3 presents the frequency and percentage of PBO buildings features such as buildings status, building classifications and building age to provide an overall perspective of the buildings under study. In the context of building status, non-Green Building dominate the overall PBO buildings with 63 percent (17 buildings) as compared with green buildings with 37 percent (10 buildings). The data also showed the classification of PBO buildings. This research uses 63 percent of conventional PBO buildings without green certification, while the rest are with GB certification including certified, gold and platinum.

Table 3 also indicates that the age of PBO buildings under this study is a mixture of new and old buildings. The highest frequencies were observed in three (3) different age groups where PBO buildings with 0 to 5 years recorded 29.6 percent, and 25.9 percent each for 16 to 20 and 21 to 25 years age groups. These almost equal variations of ages between PBO buildings involved in this study allow considerations and analysis of buildings of different building age categories.

| Item            | Particular       | Frequency | %    |
|-----------------|------------------|-----------|------|
| Building Status | Non-Green Building | 17        | 74.1%|
|                 | Green Building   | 10        | 25.9%|
| **∑**           |                  | **27**    | **100.0%** |
| Building Classification | No Classification | 17        | 74.1%|
| Certified       | 8                | 20.4%     |
| Gold            | 1                | 1.9%      |
| Platinum        | 1                | 1.9%      |
| **∑**           |                  | **27**    | **100.0%** |
| Building Age    | 0 to 5           | 8         | 29.6%|
|                 | 6 to 10          | 1         | 3.7% |
|                 | 11 to 15         | 1         | 3.7% |
|                 | 16 to 20         | 7         | 25.9%|
|                 | 21 to 25         | 7         | 25.9%|
|                 | 26 to 30         | 3         | 11.1%|
| **∑**           |                  | **27**    | **100.00%** |

4.2. Analysis of depreciation between certified green and conventional buildings

4.2.1 Analysis of depreciation rate

Overall, the results showed the rates of depreciation for PBO buildings in 2014 were positively correlated to the age of the buildings. Table 4 shows that the rate of depreciation for most PBO buildings increase when the buildings is older. The range of depreciation rate for the PBO buildings within the dataset was 0 percent to 73.33 percent. The average rental depreciation for 2014 was recorded at 46.77 percent. The depreciation rate for buildings with 1 to 8 years of age was recorded below the average depreciation rate of whole selected buildings (between 0 to 42.86 percent). This pattern of depreciation supports the result obtained by Yusof (2000) where offices with less than 9 years of age, will have a lower rate from the average depreciation rate. The pattern of depreciation (refer Fig. 1) shows the rate was gradually increasing at the age of 0 to 14. Despite, in some buildings, the age did not reflect the depreciation rates. For instance, even when the PBO buildings is eight years old, the depreciation was observed
higher (57.14 percent) than the building with twenty-one years of age (49.52 percent). These phenomena can be related to the quality of the PBO buildings in the dataset.

In addition, this research has also found out that buildings with green building certification obtained higher rental rate than the conventional buildings thus make it more resistance to rental depreciation in year 2014. By referring to Table 5, the green buildings depreciated between 0 to 42.86 percent from the prime rental in the GT area. In comparison to the conventional buildings, the minimum rate of depreciation was 33.33 percent while the maximum depreciation rate was recorded at 73.33 percent.

4.2.2 Results from the correlation analysis

Correlation analysis was used in this study for the purpose of determining the relationship between rentals and other independent variables. In addition, it is able to assess the strength of association between variables involved in this depreciation studies. This section will present the results together with the explanation of the association between rental depreciation rate and age, building category and building classifications. Results of the analysis using Pearson correlation indicate the types of relationship and the strength exist between variables. Table 5 shows the Building Age was positively correlated with Depreciation rate of PBO buildings. Strong positive association was observed. It can be inferred that as the age of the PBO building increases, the depreciation rate of PBO would follow suits \((r = 0.745, p<0.01)\). Surprisingly, other variables such as Building Category and GBI classification produced a negative association with Rental Depreciation. This parallel relationship shows that when building status or building classification increases to Green Building, the Depreciation rate will decreased, \(r = -0.781, p<0.01\) and; \(r = -0.780, p<0.01\). The relationships were also considered of strong relationship.
Table 6. Correlations of observed average rental, building age, status and GBI classification.

| Variable                        | 1   | 2   | 3   | 4   |
|---------------------------------|-----|-----|-----|-----|
| 1. Dep.                         | --  | 0.75* | --  | --  |
| 2. Building Age                 | 0.75* | --  | 0.77* | --  |
| 3. Building category            | 0.77* | 0.76* | --  | --  |
| 4. GBI Classification           | 0.76* | 0.78* | 0.68* | --  |

** denotes correlation is significant at the 0.01 level (2-tailed).

*Note: Coefficient above represent the correlation of raw construct for total sample (N = 27). All coefficient are significant, p<.01.
4.2.3 Results from the regression analysis

Firstly, the analysis of regression using the enter method has found out the Building Category and GBI Classification explain a significant amount of the variance in the value of rental depreciation for 2014 \( F(2,24) = 27.13, p<.05, R^2 =0.693, \ R^2_{Adjusted} =0.668 \). This model has identified that both independent variables were significant in affecting depreciation of rental. The analysis demonstrates that building category significantly predicts the rental depreciation \( \beta = -0.447, t(26)= -2.581, p<0.05 \) together with building classification \( \beta = -0.441, t(26)= -2.544, p<0.05 \). Generally, the model suggests that buildings with green certification are able to reduce the impact of depreciation as compared to the conventional buildings. The reason was due to the features of the green building itself; which are equipped with modern specification, energy efficient, good reputation and demanded by tenants. As such, green PBO buildings are able to command higher rental from this perspective and existing tenants. To assess the multiple effects of independent variables on the rental depreciation of Purpose Built Office, a multiple regression analysis was executed. The result of the regression analysis is reported in Table 7.

| Variable            | Coefficient |
|---------------------|-------------|
| Constant            | 72.435      |
| Building Category   | -15.584     |
| GBI classification  | -7.760      |
| N                   | 26          |
| R^2                 | 0.693       |
| Adj. R^2            | 0.668       |
| F                   | 27.123*     |

The regression model for rental depreciation 2014 is as follows:

\[
\text{RentalDep2014} = 72.435 - 15.584 \text{ (Build Category)} - 7.76 \text{ (GBI Class)} \quad (3)
\]

5. Summary and Conclusion

The analysis conducted shows that the depreciation of PBO buildings in Kuala Lumpur GT can be originated from the green certification. Office buildings without green certification were analysed to have higher depreciation rate as compared with Green certified office buildings. Analysis conducted showed the average depreciation rate for green PBO buildings is lower than the average depreciation rate for conventional buildings (GB =29.63 percent; Non GB = 56.85 percent). From the statistical analysis results, the building categories (green or non green) and building classifications (Not Certified, Platinum, Gold, Silver and Certified) tend to have a strong correlation to the rental depreciation rate of PBO buildings. The negative correlation denotes the rental will depreciate further if the buildings category and building classification degraded into conventional building. Meanwhile, factors of building categories and building classifications were proven to have a significant impact towards rental depreciation in 2014 from the multiple regression analysis. Variations in these factors explained the scale of depreciation in the case of office buildings in the study area. It can be concluded that while the building age plays an important roles to the rental depreciation, other factors such as building categories and building classifications in regards to green building certification may also influence the depreciation rate of office buildings in Kuala Lumpur. The results of the analysis provide definite evidence from the quantitative perspective on the benefits of green buildings in reducing the rental depreciation for office buildings, thus unlocking the investment potential for certified green office buildings in Kuala Lumpur and Malaysia.

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