Sources of Property Investment Depreciation : A Theoretical and Empirical Approach

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Received: August 1999
Revised: October 1999

Abstract

The paper presents theoretical and empirical analyses of the sources of property investment depreciation with particular reference to offices in the city of Kuala Lumpur. It reviews three major sources of depreciation; physical deterioration, building obsolescence and site obsolescence. The paper considers variables other than 'age' in the analysis of depreciation. The principal component analysis, eliminates multicollinearity (a common problem associated with a large number of explanatory variables) and produces orthogonal factors which have better links to the sources of depreciation, described in this paper. The study indicates that the main sources of depreciation in the city of Kuala Lumpur offices are building obsolescence and physical deterioration.

Keywords : depreciation, physical deterioration, building obsolescence, site obsolescence

Introduction

Many works on depreciation undertaken in the United Kingdom and the United States of America (US) focused on estimating its impact. However, a large number of the US works, for example, Cantwell (1988), Krasker (1982) and Clinch (1983), emphasised the importance of maximising the impact of depreciation for maximum tax shelter. Furthermore, most of the works are concerned with the analysis of residential properties' depreciation (Clapp and Giacotto, 1998; Epley, 1989; Cannaday and Sunderman, 1986; Palmquist, 1979). In the United Kingdom, the analysis of depreciation focused on methods of estimating its impact on the economic life of a building and the issue of property mispricing due to depreciation. In contrast to the USA, most of the studies focused on office properties with regards to the rapid changes in tenants' requirements. This is due to changes in the way business is performed especially with an increasing use of high-technology equipment (see Salway, 1986; Baum, 1989; Barras and Clark, 1996).

There has been little attempt to analyse sources of depreciation theoretically as well as empirically which may provide a basis for further works relating to estimating its impact on property investment performance. Some of the previous works in this area (for example, Wootton, 1986) lack a general theoretical base which resulted in a failure to identify and account for the contribution of each source of depreciation. Other works (Baum, 1989; Khalid, 1992) departed from the analysis of sources of depreciation but attempted to link these sources to its impact on property investment performance, with varying levels of success.

The importance of distinguishing each source and carefully defining it is emphasised in this paper. This is achieved by clarifying its definition, as in many cases, the definition outlines the sources of depreciation empirically. The paper also critically examines the adequacy of 'age' as a sole source and proxy for depreciation, as opposed to Sykes (1984), Salway (1986), Epley (1989), Barras and Clark (1996) which treated 'age' as main explanatory variables. This is based on the fact that 'age' is strongly correlated to other variables, such as design and finishes of the building, hence these variables may become less significant to be considered in the analysis of depreciation. The paper also addresses the problems in considering multiple depreciation factors and highlights statistical problems associated with the analyses. It also recommends a solution for the problem.

The paper is organised into three main sections. The first section provides a review of the concept and causes of depreciation along with the critical analysis of the 'age' variable as a proxy for depreciation variables. The second section contains the research design, data and discussion of the results. The final section offers concluding remarks.

Literature Review

The review is undertaken in two stages. The first stage critically defines depreciation from various sources. The second stage discusses causes of depreciation.

Definition of depreciation

Various definitions of depreciation can be found in accounting, economic and property literature. In early accounting practice, depreciation represented the portion of an asset consumed in operating the business (Bonbright, 1937 citing Guthrie, 1883). The current practice of accounting requires an allocation so that a fair proportion of a cost or valuation is charged against the expected benefits from the use of the asset over each accounting period. In property investment, depreciation is related to a decline or loss in value. The real meaning of depreciation should, therefore, be analysed through the meaning of 'value' which refers to 'that of appreciation, of worth, of favourable importance'. The 'value' is of prime concern in property investment, thus decline in value (instead of cost allocation, decline in price and physical deterioration as in accounting) is generally accepted to refer to depreciation. This general definition of depreciation is outlined by the Accounting Standard Committee (SSAP), Royal Institute of Chartered Surveyors. Additionally, Md Yusof (1999) introduces the concept of comparing rentals between offices to derive differences in rental depreciation. Accordingly, she defines depreciation as a decline or loss in value of a property in comparison with the equivalent prime modern or new property which earns the best rental in a similar market. The definition suggests that depreciation may arise from many sources which are related to values. Since these factors influence or determine property investment values, they should be regarded as depreciation variables.

Causes of depreciation

Many depreciation studies have focused on two broad sources of depreciation, physical deterioration and obsolescence; for example in the field of accounting (Chapman, 1973; Baxter, 1981) and property investment (Wofford, 1983; Salway, 1986; Baum, 1989).

Physical deterioration indicates the situation of decline in utility due to physical usage and the passage of time. The importance of passage of time or age has been recognised as the principal depreciation determinant (for example Sykes, 1984; Epley, 1989), supported by strong level of associations between age and other variables such as type of design and finishes. Sources of physical deterioration comprise non-environmental and environmental factors (Flanaghan, *et.al*, 1989). Non-environmental factors refer to 'use' whilst environmental factors are related to weather and the action of elements. Therefore physical deterioration emanates from the 'use' and 'action of elements' which require the passage of time, as both 'use and action of elements' occur progressively through time. Physical deterioration is also signified by continuing expenditure. As a result, the degree or level of utilisation influences deterioration. Intensive use may also demand early capital outlays to slow down the rate of deterioration. The rate at which physical deterioration occurs is also a function of the design and the quality of construction, including the nature of the materials and the level of maintenance (Dubben and Sayce, 1991). Although physical deterioration is unavoidable, a high material and construction quality employed together with a proper maintenance as well as a reasonable level of use may slow down the rate of deterioration. This means that prudent expenditure and choosing the right materials help to minimise the impact of depreciation on property investment.

In addition to physical deterioration, studies have also identified sources of depreciation due to obsolescence (Baum, 1989; Khalid, 1992). Obsolescence is defined in these works as a decline in property utility or usefulness which is not directly related to physical deterioration. The property may become obsolete due to several factors, such as better technology or modern design of a new property. Obsolescence may also arise from very sudden or unexpected changes that cause a sharp decline in utility (The Arnolds Encyclopaedia of Real Estate, 1978). A range of obsolescence categories has been proposed: functional, economic, aesthetic, environmental, legal and social (Salway, 1986; Baum, 1989; Khalid, 1992). These categories, however, are a subset of two main categories of obsolescence: building and site (Md Yusof, 1999), since property embodies site and building.

Building obsolescence refers to a degree of mismatch between a building and its use; when the buildings or part of them can no longer match the current trend and taste. Whenever a building loses its appeal, it is no longer acceptable based on the standards by which it was put there during its prime time. For example, an increasing use of computers in the business demands an open-space office lay-out as well as sufficient floor to ceiling height. As a result, some offices which were built with large columns will be less favoured. It is clear that as the society's way of carrying out social and economic activities changes, the desirability of various properties to tenants also changes. Factors, such as a change in working fashions and a need to occupy high quality space for better business image can be seen as major sources of depreciation. Md Yusof (1999) suggests that building obsolescence may rise from four factors- three are related to the building: design, system and services. The other factor is related to site and market.

Building Design

Buildings with 'good' architecture seem to yield a higher level of rent (Vandell and Lane, 1989). As design is a function of taste within the period in which it was built, changes in taste may cause a building to become unsuitable at some period in the future. However, as mentioned earlier, the situation may be reversed, such as the recent development of fibre optic cabling which will minimise the space required for cabling. Hence, the buildings which were obsolete a few years ago are now serviceable. Types of building finishes, either internal or external, may also contribute to the building obsolescence. The potential tenants may be attracted to the buildings which were built with modern external facades and finished with high quality materials, such as granite and curtain walling compared to the old ones. As a result, older buildings are filtered to less reputable tenants at lower rents, with a greater risk of depreciation.

Building Systems

There has been increasing concern over the efficiency aspect of buildings systems which include air-conditioning, security, lift and telecommunication systems. It is important for every modern building to have a hospitable environment for the occupants and equipment within the space and at the same time minimising energy consumption in the building. Lack of efficient systems in a building may cause property to become less efficient compared to one which has been built with modern and efficient features, such as a high-speed elevator in a high-rise building. Properties will face a problem of falling standards as more and more new ones are built with higher systems specifications.

Building services become more and more important in today's properties, especially offices. The need to provide ample parking spaces may become a statutory requirement as well as a social obligation to meet the increasing demand of tenants who drive to the workplace. The number of parking spaces provided in the building may affect the demand for the property. Although, this may not be directly related to the function of the property, the need for efficient services aimed at providing comfort to the tenants may be considered by potential tenants as an important factor.

Other factors may also cause obsolescence such as 'out of town' developments. This may result in decentralisation of development. Hence, the existing town centre may be affected. Since the phenomenon is related to locational factors it is refered to as site obsolescence.

Site obsolescence is a decline in usefulness of a site (Md Yusof, 1999). In order to study the causes of site obsolescence, it is important to analyse the mechanism upon which site values are derived. The value of a site is a function of a complex series of factors, such as the general level of economic activity, property markets and local activity in the sub-market. In other words, land or site value, in general, is affected by the level of supply and demand for land which is based on the demographic structure and the patterns of land use in a particular area. The factors include the location, accessibility, service and the consumption of space available, including affordability, financing and density for development. Therefore, it is generally accepted that the value of land especially in urban areas is purely affected by the level of demand where the supply is fairly inelastic (Alonso, 1964; Ball, *et al,* 1998).

There are several factors which may cause obsolescence of a particular site or location. They include (i) accessibility factors, (ii) site specific factors, (iii) planning factors, (iv) environmental factors, and (v) other market-wide factors.

(i) Accessibility: Accessibility is the ease with which contacts can be made from one place to another (Pang, 1981). Good accessibility is always regarded as the main feature of good location, since by locating in accessible areas, the distance, cost, time and inconvenience involved in maintaining communication and linkages will decrease. This, however, may no longer be critical as electronic communication becomes widely used in business. Nonetheless, accessibility is always regarded as an important factor in locational theory. Accessibility is improved by a good or efficient transportation network which forms part of an infrastructure system. Deterioration in public transport, an alteration to the traffic systems and imposition of parking restrictions can have very damaging effects on property, especially retail. As a result of these factors, the affected site may be less favourable.

(ii) Site-specific factors include physical characteristics and size of the site. Properties in prime locations in the city centre, for example, fetch higher values compared to secondary areas. Other site-specific features such as being close to other uses (retail or offices), utilities and amenities, are also important.

(iii) Planning factors normally cover changes in planning policies, in particular areas which may affect the locational preference of the location. This includes changes in the plot ratio, zoning and development density, which either increases or decreases demand for the site. Sites or locations which are affected by adverse planning decisions are prone to obsolescence.

(iv) Environmental factors create obsolescence through changes in characteristics of an area, for example, urban decay, contamination and pollution. Gloster and Smith (cited in Adams, *et al,* 1994) stated that traditional industries had exploited the land to the point that it was unsuitable for its existing and future use. The contamination of land and the dereliction of buildings is a negative effect which may cause obsolescence.

(v) Other market-wide factors. They include social aspects, such as the state of the economy, demographic factors and changes of taste. Van Manen (1983) suggests that property, as other commodities, is also affected directly or indirectly by changes in the price of other commodities. Accordingly, changes in the level of economic activities, either at national, regional or local level, can influence demand for property.

Demographic changes rely on a mixture of planning, economic and social factors. In the short term, a shifting population may also affect the demand for properties either commercially or residentially in a particular area. In addition to this, Salway (1986) and Greer and Farrell (1992) indicate that the gradual changes in the operational methods of industry can change the locational requirement. Salway (1986) points out that others factors, such as the introduction of efficient working practices, may reduce the aggregate demand for floor space. Similarly, new economic activities such as high technology industries using flexible production and services have different locational interests and pressures, which cause the demand to fall in the inner-city areas and at the same time increase it in outer areas.

The above identified sources of depreciation arise from physical deterioration, building obsolescence and site obsolescence. In contrast, Clapp and Giacotto (1998. p. 417) suggest that residential depreciation can be defined '... as the decline in value with respect to age because of increased maintenance costs (i.e., the present value of maintenance expenditures increases at a decreasing rate with age) and decreased usefulness (because of changes in design, electrical and mechanical systems, and the like)'. They argued that depreciation is the (expected) change in intrinsic value with respect to age alone, independent of changes in demand and supply. They recognised that depreciation can change over time: neither actual nor expected depreciation is constant and changes in value due to demand changes are independent of depreciation.

The definition by Clapp and Giacotto (1998), led to a critical argument of 'age' as an explicit proxy for depreciation in either residential or commercial properties. Age has been shown in many studies to be a sufficient proxy for depreciation; that is, deterioration and obsolescence can be accounted by 'age' (although it is more difficult to show site obsolescence with 'age'). If only 'age' is considered in the analysis, it will be difficult to anticipate the impact of every source of depreciation separately. Therefore, depreciation can be explained more explicitly by considering the property characteristics (Baum, 1989; Khalid, 1992; Md Yusof, 1999). Nonetheless, analysis of a large number of independent variables in property investment is less favoured due to the difficulty of obtaining information on related variables. This is also due to the lack of tools to consider a large number of variables in the analysis as the relevant statistical technique is seldom used in property investment analysis. Furthermore, the consideration of the number of variables is normally constrained by the problem of close association or 'multicollinearity' between the explanatory variables specified in the model.

The above problems have received less attention in the analysis of depreciation. Methods such as principal component analysis (PCA) have been hardly used in property investment analysis. PCA derives the underlying dimensions of the issue under investigation by simplifying the description and understanding of depreciation. PCA overcomes several problems by reducing the number of independent variables (if there is a large number of initial independent variables, the variables are unlikely to measure different constructs) and eliminating the potential multicollinearity as the factors derived are orthogonal. A good discussion on PCA can be found in Myers (1990), Steven (1986) and Norusis (1988).

Research Design

This section describes the methodology used to identify the underlying sources of depreciation with particular reference to rental difference (expressed in percentage) as a dependent variable which is denoted as DepR. As mentioned earlier, differences in rentals between the subject property and the best or highest rental in a similar market (the city of Kuala Lumpur) represent the rate of depreciation for any particular building. A similar indicator for depreciation was used in Khalid (1992) and Baum (1989). The first stage of the work is data collection. The second stage involves the analysis of correlation between variables (dependent-independent and independent-independent). The analysis identifies variables which are significantly correlated to rental depreciation. The role of 'age' is examined and explained. The third stage of the work addresses the crucial aspect of considering the multiple causes of depreciation. The strong association between independent variables; (multicollinearity), which causes problem in the analysis is minimised by using PCA. The objective of PCA is to derive the underlying dimensions of depreciation. PCA normally proceeds in four steps:

(i) A preliminary test for an appropriateness of the analysis through an observation of correlation matrix, partial correlation and Kaiser-Meyer Olken test,
(ii) An extraction of factors where a linear combination of the observed variables are formed. 'Eigenvalue' and 'Scree test' are used to determine the number of components to be retained in the analysis,
(iii) Factor rotation which transforms the initial matrix into one that is easier to interpret or to achieve a simple structure, and
(iv) Computation of the score of each factor for further analysis.

Data

This study analyses a set of data on property characteristics and rental depreciation. Rental depreciation (denoted as DepR) for each property was derived by comparing the average rental of a particular property to the highest rental of equivalent property in the

1996 Kuala Lumpur's market. Forty-nine offices of different ages in the city of Kuala Lumpur in the data set were surveyed. The sample accounted for about 50 per cent of the city's stratified office population. The offices have been stratified to various criteria, such as tenanted building, private office and building more than 8 storeys high as well as located in the three traditional commercial areas; the Golden Triangle Area (GTA), the Central Business District (CBD) and the Decentralised Area (DCA). A total of fifty-three property characteristics was collected in the surveys. A list of the variables is shown in Exhibit 1.0. The selection of offices was based on the Kuala Lumpur City Hall classification. Excluded were cases where the rental used is not an actual rental for the building. For example, owner-occupied buildings were not selected due to the absence of rental evidence.

The characteristics collected are related to property location, building design, building services and electrical and mechanical systems as identified in the literature. The characteristics of the properties are compared to the best characteristics in the market. The quality of the characteristics are assigned with scores as appropriate. The best characteristic for a particular variable is assigned the highest score. For example, there were five types of external finishes for the buildings surveyed. The highest score (denoted as 5) will be given to granite finishes whilst the lowest (denoted as 1) was for cement plastered and painted. It is therefore, easy to relate these characteristics to rental depreciation.

Empirical results

The result of the analysis is presented in two parts: the analysis of 'age' and the multiple causes of rental depreciation. The first part aims to show that 'age' could provide a reasonable explanation for rental depreciation. However, when the data allows it, it is better to consider other causes of depreciation. A list of variables used in the analysis is in Exhibit 1.0. A series of correlation matrices for variables was computed as shown in Exhibit 2.0.

<u>Level 1</u>

A correlation between 'age' and rental depreciation indicated a value of 0.5748 in absolute values which can be considered as a moderate level of relationship (Norusis,1989). In comparison, there are many variables related to the building system which are significantly associated with rental depreciation either at the 0.05 or 0.01 significance level. These variables are negatively associated, that is, the decreasing quality of property characteristics has increased the level of depreciation. It shows that age has a reasonable association with the age of the generic in the data set. An analysis of rental depreciation and 'age' of the offices in the data set is summarised in Figure 1.0. The pattern or rate of depreciation follows a smooth curve line to indicate the actual phenomenon. In general, the level of depreciation increases as 'age' increases. However, there appears to be a distortion to the smooth line of depreciation at age 10. The peak point at age 10 suggests that 10-year old offices suffered a high level of depreciation compared to the older ones. Although some studies, such as Barras and Clark (1996), showed a linear correlation between 'age' and depreciation, it is not so for the city of Kuala Lumpur offices in 1996. The linear pattern of the Kuala Lumpur office depreciation is distorted with a high level of depreciation at age 10. The phenomenon thus requires further explanation.

As can be seen in Exhibit 2.0, there are a number of variables which are strongly associated with 'age' as well as rental depreciation. The correlation coefficient of 0.5748 between 'age' and DepR indicates that only about 58 per cent of rental depreciation variation are explained by 'age'. The possibility that the remaining 42

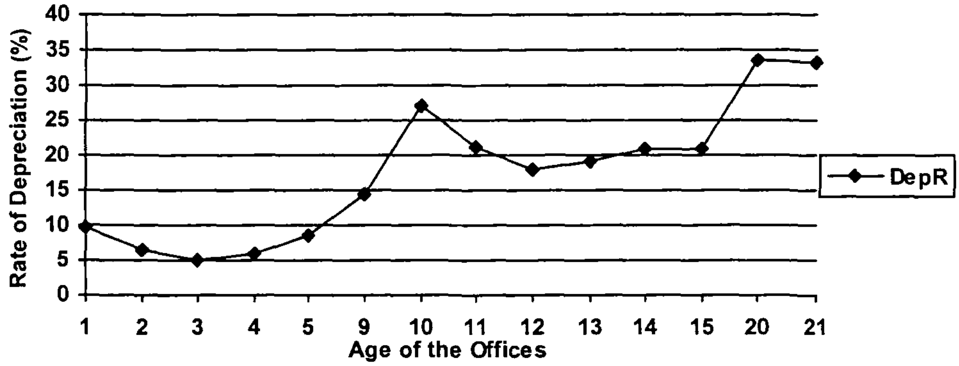

Figure 1: Rental Depreciation by Age

per cent of variation will be explained by other variables is examined in the following part.

Level 2

In Exhibit 2.0, there are a number of variables that are significantly correlated (at both the 0.05 and 0.01 significant levels) and they represent three sources of depreciation: physical deterioration, building obsolescence and site obsolescence. There are a large number of variables which are linearly associated with rental depreciation. It is, therefore, important to classify the variables under each source of depreciation to reveal and explain the underlying sources of depreciation. The significant correlation between variables as indicated in Exhibit 2.0, creates the problem of multicollinearity. Consequently, this limits the attempt to consider more variables in the analysis of depreciation. As mentioned earlier PCA is used to address the problem of multicollinearity. In principal component analysis, thirty-seven variables were selected based on the significant level of association with DepR. The inclusion of location-related variables is an attempt to complement the other site-related measures in order to consider the effect of site obsolescence.

The first step in the Principal Component Analysis is to observe relevant associated statistics. The analysis used three levels of statistics: Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO), Bartlett Test of Sphericity and significance level to determine the appropriateness of PCA to explain rental depreciation. A summary of initial and final statistics is shown in Exhibit 3.0. Based on the Eigenvalue of more than '1' in the initial and final statistics, eight components or factors have been derived in the analysis which explained 74.7 per cent of the variation in rental depreciation. The closer the KMO is to '1', means that correlations between pairs of variables are well explained by the other variables (See Norusis, 1989). The KMO of 0.70365 indicates a 'middling' situation for the PCA to be performed (Kaiser, 1960). The components or factors were rotated using the Varimax rotation method to simplify the interpretation. A summary of factors is shown in Table 1.0. Variables with loading of less than 0.2 are suppressed from the matrix.

Factor 1 is a combination of thirty-one variables, most of which have significant loading (more than 0.3). Among the features that obtained high score in factor 1 were Building Automation System (BAS), floor

Table 1.0: A Summary of Rotated Factors - Factor Model 1
(Rental Depreciation - DepR)

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
Bas	0.87834	0.23470						
Fire	0.86085	0.21599						
Ac_fl	0.85660							
Cr_fin	0.81943	0.40123						
Ac_sys	0.79886	0.29250						
Lif_con	0.73974	0.2218	0.23623	0.26494				
Spautl	0.73763	0.21110	0.33009					
Security	0.69925				0.21456			
Wait_car	0.68396	1.41094			0.24674			
Int_car	0.68042	0.41281						
Ce_high	0.67139	0.25368	0.36080					
Spd_car	0.65230	0.44478						
Age	-0.6457		-0.27078		-0.2127		-0.3619	
Lop_fin	0.60613		0.46831			0.25281		-0.2791
Ty_con	0.58347		0.28886		0.54475			
Schrg	0.58072	0.32799		0.23272	0.23858		0.25063	
Comm	0.55425				0.49492	0.25684	-0.2200	
Ex_fin	0.54429		0.35433		0.48427			
Fl_fin	0.42897			0.40333		0.41760	0.21337	
Fl_area	0.27058	0.83739						
Nt_let	0.35436	0.81319						
Lif_car	0.31524	0.79005	0.22471		0.20333			
Bay	0.38264	0.78278						
Stry	0.32056	0.61937	0.21132					0.43052
Ld_area		0.60879			0.22462			-0.4137
Re_count	0.33624	0.55291					0.33891	
Lobby	0.34039		0.70515					
Bay_rate	0.28630	0.26606	0.57093	0.24299			-0.2368	-0.3416
Gym			0.53352				0.50643	
Locat	-0.21084			0.85348				
Ty-bay	0.41789			0.72417				0.25862
Lascap	0.33170	0.32342		0.39946	0.36963	0.25269		
Dine					0.68054		0.45437	
Prox						0.82223		
Cm-ref		0.43957				0.65133		
Conf	0.21615						0.82699	
Plratio								0.80980

finishes (Flfin) and variables which are related to building systems. This factor reveals a good quality building due to the high scores of variables under the factor. The factor explains that the largest variation (43.3 per cent) in rental depreciation is due to 'Building Quality'. Building quality is thus an important cause of depreciation.

Factor 2 comprises two groups. Group 1 is a combination of variables which are related to efficiency (for example, Spd_car and Wait_car are used to measure the efficiency of the lift system). Group 2 consists of variables with loading higher than 0.5. This group seems to represent the 'size' dimension (for example, Stry, Fl_area and Ld_area). The link between the two groups explains that as the size of the building increases, more efficient services are needed. Factor 2 which can be identified as 'Size and Efficiency' explains a further 7 per cent of variation in rental depreciation.

Factor 3 indicates design and lay-out dimension as one of the rental determinants which influences rental depreciation. The 'design and lay-out' factor accounts for 5.6 per cent of the variation in DepR.

Factor 4 is identified as Location (Locat), which is a combination of the siting of the offices, the parking provisions and the state of the property landscape. Offices in good locations are mostly new buildings normally accompanied by a higher parking to floor space ratio. The offices are usually well-planned and built with better landscapes.

Factor 5 represents the dimension of 'appearance' of the offices, with variables related to the design such as Fl_fin (Floor finishes). Nonetheless, it accounted for only 4.2 per cent of the variation in rental depreciation.

Factor 6 represents the 'Complementary' dimension, comprising nine variables. However, only the two with very high loadings are used as a basis for interpretation. The factor also measures the closeness of the building to other users.

Factor 7 indicates the aspect of 'facilities' of the property and accounts for 3.2 per cent of the variation in rental depreciation.

Factor 8 explains only 3.1 per cent of the rental depreciation variation. The factor combines development, age and storey as well as 'Bay_rate', interpreted as 'Parking'.

Overall, the above PCA extracted eight components from thirty-seven property-specific variables. The link between the factors and sources of depreciation is developed in the following part.

Link Between Factors and Sources of Depreciation

The results from the PCA categorised thirty-seven variables into eight depreciation factors. Note that 'age' has a lower loading compared to other variables and tends to appear in many factors, indicating a close association between age, the variables and factors. The link between eight factors to the three sources of depreciation: physical deterioration, building obsolescence and site obsolescence, is now explained. Physical deterioration, as mentioned earlier, is related to the normal wear and tear of physical, mechanical and electrical systems. Building obsolescence is regarded as the degree of mismatch between the building and its use as a result of changes in external factors such as changes in technology or user preferences. Site obsolescence, is referred to as a decline in the usefulness of the site caused by changes in locational preferences.

The eight factors derived are 'Building Quality' (BldgQty), 'Size and Efficiency'(SizeEff), 'Appearance' (Appear), 'Location' (Locat), 'Design and Lay-out' (DesLay), 'Complementary' (Compl), 'Facilities' (Facil) and 'Parking' (Park). Building Quality can be linked to physical deterioration-related factors. 'DesLay', 'Park', 'Facil' and 'Appear' can be classified as building obsolescence factors, as a decline in the usefulness of these factors could lead to obsolescence and consequently depreciation.

Nevertheless, there were problems in classification as 'SizeEff' and 'BldgQty' may also indicate building obsolescence and some building obsolescence factors may also indicate deterioration. The possible distinguishing feature between them is that physical deterioration is concerned with wear and tear but obsolescence is related to property qualities which correspond to changes in demand. Site obsolescence can be proxied by 'Locat' and 'Compl' in this study. The above factors indicate the possibility that offices may be greatly affected by building obsolescence.

Summary and Conclusions

This paper shows that depreciation arises from physical deterioration, building obsolescence and site obsolescence. Physical deterioration is related to the decline in utility due to physical usage and the action of elements which occurs progressively through time. Obsolescence is a decline in property utility or usefulness but is not related to physical deterioration. Studies based on the assumption that depreciation is linearly related to 'age' are found to be less relevant especially in the case of Kuala Lumpur offices in 1996. The pattern indicated that based on empirical evidence, age was insufficient to explain the phenomena of depreciation. Based on real office property in the city of Kuala Lumpur, the characteristics are summarised in the PCA to derive the underlying factors or components of depreciation. Eight components as described in the earlier part of this paper are linked to the three sources of depreciation. The paper has shown that it is possible to consider a large number of depreciation factors. However, further approaches such as using Multiple Regression Analysis and its extension, the Hedonic Price Technique, should be used to determine the relative importance of each of the factors.❑

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EXHIBIT 1.0 A LIST OF VARIABLES IN THE STUDY

Labels	Description
1. Ac_sys	Air-conditioning system in the building. The variable is measured by score with higher values for better and modern systems.
2. Ac_fl	The variable indicates whether the air-conditioning system is equipped with the latest feature of system; Variable Air Volume. The score is indicated by Yes or No.
3. Access	The variable used to describe the accessibility of the property from the main road and public transport
4. Age	Age of the building
5. DepR	Annual Depreciation on Rent
6. DepY	Annual depreciation on Yield
7. Bas	Explains the state of the building automation system of the building. Modern or best system denoted by higher scores.
8. Bay	Number of parking spaces provided in the building
9. Bay_rate	Indicates percentage provision of parking spaces based on floor area and space ratio
10. Big_spac	The biggest space occupied by a single tenant in the building
11. Bigs_ten	Number of bigger tenants occupying space of 5,000 square feet and above
12. Ce_high	Measured floor to ceiling height, more or less than 10 feet
13. Comm	Telecommunication system in the building
14. Cm_ref	Shows whether a common refreshment area is available in the building
15. Conf	Conference hall or room in the building
16. Cr_fin	The state of architectural finishes of lift car
17. Dine	Dining facility
18. Ex_fin	External finishes of the building
19. Fn_com	Tenants profile - Finance Companies
20. Fire	Fire prevention system of the building
21. Fl_area	Gross floor area of the building, denoted by several categories
22. Fl_fin	Building floor finishes
23. Gen_com	Type of the ownership - general commercial
24. Govtagen	Tenants profile - Government agency
25. Gym	Gymnasium facility
26. Int_car	Car interval movement
27. Lascap	The state of landscape in the building
28. Ld_area	Land area of the property
29. Lif_car	Number of lift cars
30. Lif_con	The control system for the lift
31. Locat	Location of the property - Three commercial areas in Kuala Lumpur used
32 Mj_Inst	Type of ownership - Major institution
33. Numten	Number of tenants in the building
34. Occrate	Occupancy rate of the building
35. Owrel	Relationship to owner
36. Plratio	Plot ratio of the property

37. Profser	Tenants profile - professional service
38. Prox	Proximity to other uses such as retail
39. Rd_fr	Is the property situated on road frontage
40. Re_count	The state of reception counter in the building
41. Refur	Any refurbishment undertaken
42. Rnt_rev	Rent review interval
43. Schrg	Service charge, measured as a fraction of gross rent
44. Security	Security system of the building
45. Sp_utl	The space utilisation (Column free, etc.)
46. Spd_car	The speed of the lift cars
47. Stck_br	Tenants profile - Stock broker
48. Stry	Number of storeys
49. Trdagen	Tenants profile - Trade agent
50. Ty_bay	Type of bay provided in the building
51. Ty_con	Type of construction- modern, transitional or traditional
52. Use_lev	The intensive use, based on type of business and number of tenants
53. Wait_car	The average waiting time during peak hours

EXHIBIT 2.0 CORRELATION MATRICES:

	AGE	DEP_R
AC_FL	-.7184**	-.6377**
AC_SYS	-.6517**	-.6312**
ACCESS	.0545	-.1958
AGE	1.0000	.5748
BAS	-.6186**	-.6251**
BAY	-.4378**	-.6342**
BAY_RATE	-.2802	-.3947**
BIGSPAC	-.2268	-.1417
BIGSTEN	-.0270	.0785
CE_HIGH	-.5887**	-.6860**
CM_REF	-.3585*	-.4773**
COMM	-.4701**	-.4973**
CONF	-.1111	-.3438*
CR_FIN	-.6453**	-.6865**
DEP_R	.5748**	1.000
DEP_Y	.4986**	.4064**
DINE	-.2513	-.3312*
EX_FIN	-.6332**	-.5252**
FINCOMP	.0265	-.0987
FIRE	-.6337**	-.5622**
FL_ARE	-.2823*	-.5411**
FL_FIN	-.2554	-.4986**
GEN_COM	.0001	.1479
GOVTAGEN	-.0153	.1651
GYM	-.2437	-.3558*
INT_CAR	-.4677**	-.5781**
LASCAP	-.3326*	-.5343**
LD_AREA	-.1499	-.2971*
LIF_CAR	-.4931**	-.6118**
LIF_CON	-.4876**	-.5988**
LOB_FIN	-.4837**	-.5403**
LOBBY	-.4043**	-.4594**
LOCAT	.1048	-.1586
MAJ_INST	-.0001	-.1479
NT_LET	-.4308**	-.5864**
NUMTEN	.1592	-.0438
OCCRATE	.3051*	.1349
OWNREL	-.0609	-.1193
PLRATIO	-.2843*	-.2938*
PROFFSER	-.0741	.0299
PROX	-.3713**	-.3398*
RD_FR	.1279	-.0590
RE_COUNT	-.3595*	-.3170*
REFUR	.3289*	.1539

RENTGRWT	.3652*	.2986
RT_REV	-.4755**	-.5512**
SCHRG	-.2883*	-.6886**
SECURITY	-.6001**	-.5800**
SIGN	-.1915	-.2638
SPAUTL	-.7307**	-.6594**
SPD_CAR	-.5302**	-.6834**
STOCKBR	.1775	-.0501
STRY	-.4473**	-.5847**
TRADAGEN	-.1392	-.1844
TY_BAY	-.4039**	-.5713**
TY_CON	-.5945**	-.4088**
US_LEV	.1686	.3789**
WAIT_CAR	-.4568**	-.5918**

* - Signif. LE .05 ** - Signif. LE .01 (2-tailed)

" . " is printed if a coefficient cannot be computed

EXHIBIT 3.0 PRINCIPAL COMPONENT ANALYSIS

Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.70365
Bartlett Test of Sphericity = 1551.7976, Significance = 0.00000
Extraction 1 for analysis 1, Principal Component Analysis (PC)

Initial Statistics:

Variable	Communality	Factor	Eigenvalue	Pct of Variance	Cum Pct
Ac_Fl	1.0000	1	16.00847	43.3	43.3
Ac_Sys	1.0000	2	2.57951	7.0	50.2
Age	1.0000	3	2.05512	5.6	55.8
Bas	1.0000	4	1.81071	4.9	55.8
Bay	1.0000	5	1.56792	4.2	60.7
Bay_rate	1.0000	6	1.35546	3.7	64.9
Ce_High	1.0000	7	1.16715	3.2	68.6
Cm_ref	1.0000	8	1.09698	3.0	71.7
Comm	1.0000	9	0.99219	2.7	74.7
Conf	1.0000	10	0.85119	2.3	77.7
Cr_fin	1.0000	11	0.78880	2.1	79.1
Dine	1.0000	12	0.74141	2.0	81.8
Ex_fin	1.0000	13	0.67992	1.8	83.8
Fire	1.0000	14	0.59962	1.6	85.7
Fl_are	1.0000	15	0.58589	1.6	87.3
Fl_fin	1.0000	16	0.54197	1.5	88.9
Gym	1.0000	17	0.50979	1.4	90.3
Int_car	1.0000	18	0.45806	1.2	91.7
Lascap	1.0000	19	0.39122	1.1	92.9
Ld_area	1.0000	20	0.33623	0.9	94.0
Lif_car	1.0000	21	0.28165	0.8	94.9
Lif_con	1.0000	22	0.22817	0.6	95.7
Lob_fin	1.0000	23	0.22116	0.6	96.3
Lobby	1.0000	24	0.19368	0.4	96.9
Locat	1.0000	25	0.16285	0.4	97.4
Nt_let	1.0000	26	0.14884	0.4	97.9
Plratio	1.0000	27	0.13864	0.3	98.3
Prox	1.0000	28	0.10798	0.3	98.6
Re_count	1.0000	29	0.10265	0.2	98.9
Schrg	1.0000	30	0.08281	0.2	99.2
Security	1.0000	31	0.06438	0.1	99.4
Spautl	1.0000	32	0.03720	0.1	99.6
Spd_car	1.0000	33	0.03651	0.1	99.7
Stry	1.0000	34	0.02874	0.1	99.8
Ty_bay	1.0000	35	0.02234	0.1	99.9
Ty_con	1.0000	36	0.01859	0.1	1000.0
Wait_car	1.0000	37	0.00617	0.0	1000.0