Quality, Depreciation, and Property Performance

Andrew E. Baum*

Abstract. There are many ways in which quality can be defined for real estate. This paper demonstrates the uses of a classification of building quality (as opposed to locational quality) defined with particular reference to occupier utility. First, it is clear that age is related to this definition of quality. Buildings deteriorate and become obsolete as they age. However, some depreciate more quickly than others. The depreciation rate is a function of age but also of building quality or qualities. By measuring building depreciation and developing a classification of building qualities, it was possible to relate qualities to depreciation in order to prove that a stronger and more meaningful relationship exists between quality and depreciation than that which exists between age and depreciation. It is also clear the obsolescence factors, especially configuration and internal specification, are more important in this respect than deterioration factors. This was established by means of intensive questioning of real estate professionals and backed up by a survey of occupiers.

The survey of occupiers was particularly important in three respects. First, it gave support to the selection of building qualities that appear to have been correctly determined by professionals and to have reflected the views of the occupier market. Second, the ranking of qualities as predictors of depreciation was confirmed: deterioration is least important and internal specification and configuration are most important. External appearance was disappointingly unimportant for London office occupiers. Hence a hierarchical approach confirmed the statistical approach. Thirdly, a further analysis of the four qualities shows clear results, especially the predominance of layout over floor to ceiling height in the configuration factor and the importance of services in internal specification.

It appears that there is a relationship between quality and return. Further work (see Baum, 1989) suggests that pricing does not efficiently reflect these factors. Occupiers' preferences can probably be built into design without necessarily impacting on cost to an equal and opposite degree; investment returns will then be delivered, inter alia, by the resistance of rental values to depreciation.

Introduction

Quality

The issue of quality often arises in the property market. In property investment, it is thought that quality might improve investment return or reduce risk; in property development, it is thought to lead to profit. What is quality? How might it lead to high returns, high profits or low risk?

*Department of Land Management and Development, Faculty of Urban and Regional Studies, University of Reading, Whiteknights, PO Box 219, Reading, England RG6 2BU.
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Quality in real estate must be connected to site (location) or building. Much has been written about the quality of location. This paper concentrates on the quality of buildings in terms of occupier utility and (indirectly, therefore) for investors. It sets up the thesis that quality in buildings can be defined as resistance to depreciation; it measures depreciation rates in office buildings in the central City of London; and it relates depreciation rates to building quality.

*How Can Quality and Total Return Be Related?* Property developers will always attempt to maximize expected net present value (NPV). How to do this will depend on the relationship between income, future capital value and cost. Future capital value is a derivative of income growth and future yield. All things equal, increased cost will reduce NPV while increased income and capital value will increase NPV. All things are not equal, however, and increased cost can be expected to have an impact upon income and capital value. The issue, then, is whether increased cost will lead to higher income and/or capital value sufficiently to raise NPV.

Investors are typically more interested in maximizing annual (total) returns than in maximizing net present values. In economics terms, then, the developer/investor should continue to incur marginal costs to the point where the marginal annual return is the same as the marginal annualized cost.

Where total return $TR$, income $Y$, land value plus construction costs $P$ and $CV1$ = capital value of completed development on sale:

$$TR = (Y + CV1 - P)/P.$$  

Greater expenditure on design and materials increases $P$ but may also increase $Y$ and $CV1$ with the result that total return may or may not increase.

'Front-loading' the construction cost may also improve building quality in terms of reducing the costs in use for the occupier, which may lead to a higher rental value. Further, improved perceptions of quality among investors may reduce the selling yield. Finally, and importantly in terms of the main subject matter of this paper, *rental value may be maintained over a longer period* by the quality of the building.

High quality may therefore lead to higher rental income and/or higher capital values. It may or may not lead to higher returns.

*How Are Returns Delivered?* The Fisher equation (Fisher, 1930) is the classical starting point for explaining required returns from investments. It states:

$$e = p + i + r,$$  \hspace{1cm} (1)

where these are all annual rates of return and

- $e$ = total return required from an investment,
- $p$ = reward for liquidity preference or consumer impatience,
- $i$ = expected inflation,
- $r$ = risk.

The required return on U.K. index-linked gilts, the closest available proxy for a true risk-free asset, is given by $p$; the required return on U.K. government bonds, riskless
in nominal terms and known as conventional gilts (ignoring, for simplicity, the inflation risk premium) is given by \((p + i)\). These may both be regarded, simplistically, as risk-free rates, the first a real RFR, the second a nominal one.

The Fisher equation can therefore be rewritten as

\[
e = RFR + r,
\]

(2)

where \(RFR\) is a nominal risk-free rate (conventional U.K. gilts, treasury bills) and \(r\) is the reward for risk, called a risk premium.

Gordon's growth model, developed and popularized by Myron Gordon and summarized in Brigham (1982), relates the required total return to the available initial return, as follows:

\[
k = e - g,
\]

(3)

where

\[\begin{align*}
k & = \text{initial yield from an investment,} \\
e & = \text{total return required from an investment,} \\
g & = \text{annual expected growth in income.}
\end{align*}\]

Rearranging: \(e = k + g\) (Gordon), \(e = RFR + r\) (Fisher), so

\[
RFR + r = k + g.
\]

(4)

which relates the required return (left-hand side) with the expected return (right-hand side). To explain the initial yield on an investment, the equation can be rearranged as follows:

\[
k = RFR + r - g.
\]

(5)

**Depreciation**

Equation 5 is used as an explanation of the dividend yield on equities or stocks. Its application to property is complicated by two factors.

First, the simplifying assumption of the model is that income is received annually in arrear, with dividends increasing from year to year as company profits improve. This is not strictly appropriate for U.K. equities, as dividends are received twice yearly, but the error is very small. For U.K. property, the error is more of a problem, as five-yearly rent reviews complicate the cash flow pattern, which becomes partly fixed interest and partly equity.

Second, the model requires the estimation of expected income growth. For equities, the estimation of expected dividend growth across the market is driven wholly by expectations of economic growth, profit generation and profit share. For property the estimation of expected rental growth across the market is also driven by expectations...
of economic growth: but the effect is not as direct. Buildings age and become less valuable purely as a result of the passage of time. This is not true of companies, which are continually able to regenerate themselves.

Buildings depreciate through deterioration and obsolescence. Expected growth in income is calculated gross of this, so it needs to be taken into account. Baum (1988) develops Fisher and Gordon further, as follows:

\[ RFR + r = k + g - d. \]  

Equation 6 theorises that the required return on a property is a function of the risk free rate and the required risk premium for the property; the expected return is a function of the initial yield, the expected income growth and expected depreciation. The lower the expected rate of depreciation, all things equal, the better is the building as an investment.

\section*{Structure}

Section 2 of this paper sets up a taxonomy of building quality as the reverse side of depreciation. Section 3 discusses methods of measuring depreciation. Section 4 describes the assembly and preparation of the database used in the empirical study which applies the chosen method. Section 5 describes the analysis and the results, while section 6 draws conclusions.

This paper describes detailed work on offices only. Industrial and (briefly) shopping centres are covered in Baum (1989) and Baum (forthcoming 1994).

\section*{What is Quality?}

\subsection*{Building Design}

Baum (1989) discusses many references to the impact of building design on investment returns. For example, Povall (1986) is unequivocal in his opinion of the major cause of commercial building depreciation. He describes inflexibility as the key. In addition, DEGW have referred to service provision, floor to ceiling height, plan layout and building image as the four main concerns of City of London office tenants, all leading to the need for a flexible stock (Duffy, 1986). Coates (1986) describes how ‘core and shell’ approaches to property development improve building flexibility, which in turn ‘enhances letability’.

Healey and Baker undertook a national survey of office design in the U.K. in 1986–7. The report of this research (Healey and Baker, 1987) shows that design factors increasingly affected rental value. The report also ranked building design factors in order of importance. These were, in order, as listed below.

\begin{itemize}
  \item i. internal environmental control,
  \item ii. heating system,
  \item iii. improved car parking,
\end{itemize}
iv quality of internal finishes,  
v security,  
vi provision for cable trunkings,  
vii toilet facilities,  
viii entrance hall,  
ix lift performance/reliability,  
x arrangements for kitchen/catering facilities, and  
xi external appearance of building.

This was a somewhat incomplete listing of building design factors (for example, plan layout of floors is absent). Nevertheless, it identified areas of potential obsolescence in office buildings.

Ferguson (1987) provides further details of expanding demands on office design emphasising the need for flexible flooring and high quality internal environmental services. Building design factors clearly impact upon obsolescence and then upon return.

**Depreciation and Obsolescence**

It is clear that depreciation and obsolescence are related to quality. The terms ‘depreciating’ and ‘obsolete’ may be used to imply low quality. Quality can therefore be defined as resistance to depreciation and obsolescence, and it is likely that these factors impact heavily upon investment return.

*Depreciation* is a loss in the real existing use value of property, whereas *obsolescence* is one of the causes of depreciation (Baum, 1989). It is a decline in utility not directly related to physical usage or the passage of time. Much of the perceived complexity of depreciation is related to the fact that an obsolescent property investment can increase in value, whereas the popular understanding of obsolescence is that it causes a decrease in value. Two factors explain this apparent problem.

Firstly, in a period of inflation property rents generally increase while yields (capitalisation rates) might remain relatively stable over the longer term. In addition, U.K. property has delivered real returns of 4%-6% per annum over the last twenty years or so. As a result, obsolescence may be obscured by rising capital values. It is therefore best reflected not in falling values but in underperformance in relation to an index of prime property values. This explains the use of the word ‘real’ in each of the above definitions. A loss in real value — depreciation — may therefore be explained as underperformance in relation to an index of newly prime properties.

Secondly, obsolete properties can increase in real value as a result of advantageous planning decisions, such as permission for increasing the plot ratio of an office site. What is therefore of interest is obsolescence leading to depreciation in the real existing use value of a property investment.

*Tenure-Specific and Property-Specific Depreciation*  Depreciation in the real existing use value of a property investment may result from tenure-specific or property-specific factors. Tenure-specific factors are the results of leases, tenancies and government regulations which restrict or encumber the investment. Property-specific depreciation, on the other hand, affects the property regardless of tenure.
Site Value and Building Depreciation  The existing use value of a property investment may by notionally split into two parts: site and building. While the site value may increase or decrease in real terms over time as the result of a complex series of factors, the building value will almost certainly depreciate in real terms.

Building Depreciation  Building depreciation is also the result of two distinct factors. Physical deterioration may be defined as deterioration of the physical fabric of the building as a function of use and the action of the elements.

Obsolescence, in contrast to physical deterioration, is a value decline not directly related to use, the action of the elements, or the passage of time. Obsolescence may be instantaneous as a result of a technological advance. It results from change which is extraneous to the building in question, such as changing market perceptions about such factors as quality and design.

Forms of Building Obsolescence  Salway (1986), drawing upon the standard U.S. literature typified in Wurtzebach and Miles (1991), refers to further categorizations of building obsolescence. These are as follows:

- aesthetic (or visual) obsolescence, resulting from outdated appearance;
- functional obsolescence, the product of technological progress which causes changes in occupiers' requirements, impinging upon both layout and facilities offered;
- legal obsolescence, resulting from the introduction of new standards (for example, safety regulations); and
- social obsolescence, resulting from increasing demands by occupiers for a controlled environment and improved facilities.

Legal and social obsolescence can be regarded as subsets of functional obsolescence which is thereby to be distinguished from aesthetic obsolescence. It is therefore possible to identify two major obsolescence types. These are functional obsolescence and aesthetic obsolescence.

Building Qualities  
From the literature reviewed in Baum (1989), the following distinction between three fundamental determinants of building quality is suggested as a useful basis for analysis.

1. The external appearance, entrance hall and common parts of the building together produce a psychological and visual impact that may alter as market perceptions of design quality change, acting through aesthetic obsolescence to create building obsolescence.

2. The internal specification, affecting both the quality and quantity of finishes and services, will have both an aesthetic and functional impact as market demands change. The appearance of the interior may become inferior as fashions change, while the productivity of those who work in the building.
may be inhibited by outdated services and fittings. Both aesthetic and functional obsolescence result.

3. As technology progresses, buildings need to be sufficiently flexible to cope with raised floors, suspended ceilings, revised internal layouts and so on. A lack of flexibility is a source of functional obsolescence as the demands of a market change. Configuration is the horizontal and vertical layout of a building, which acts largely through functional obsolescence to make a building less useful (obsolescent) as requirements change.

**A Full Taxonomy**

A study of the literature relating to the building design aspect of depreciation shows that each of the basic building qualities (external appearance, internal specification and configuration) naturally breaks into further subfactors and that a further distinction based on these subdivisions may be useful.

Firstly, external appearance is a function not only of the pure external design but also of the entrance hall to the building, which is clearly perceived as part of the 'external' image. Individuals feel external to the building until admitted past the reception desk (Healey and Baker, 1987). Secondly, internal specification affects both the design and quality of internal finishes (doors, walls and so on) and the design and

**Exhibit 1**

A Classification of Depreciation and Obsolescence

![Diagram of Depreciation and Obsolescence classification]

- **DEPRECIATION**
  - Property factors
  - Tenure factors
    - Site value changes
    - Environmental obsolescence
      - Supply demand
      - Building depreciation
        - Physical deterioration
          - External appearance
          - Internal specification
          - Configuration
        - Building obsolescence
Exhibit 2
Building Qualities

| Configuration          | plan layout;          |
|                       | floor-to-ceiling height |
| Internal specification| services;             |
|                       | finishes              |
| External appearance   | exterior;             |
|                       | common parts          |
| Durability of materials| resistance to external deterioration; |
|                       | resistance to internal deterioration |

quality of services (lifts, air conditioning, and others) (Ferguson, 1987). Thirdly, configuration is a function of both horizontal and vertical layouts, in other words, of plan layout and of floor-to-ceiling heights (Duffy, 1986; Pepper and Morgan, 1986).

Exhibit 1 shows the complex relationship of deterioration and obsolescence and of external appearance, internal specification and configuration. The breakdown of the latter three factors into pairs of subfactors (external design and impact of entrance/common parts, internal finishes and services, and floor-to-ceiling heights and floor layout) is further developed in Exhibit 2. These could be further classified into more subfactors for a more detailed analysis.

Measures of Depreciation

Introduction

A measure of building depreciation within which obsolescence can be identified should initially be achieved by distinguishing site and building factors. Site value changes and building depreciation should be isolated in order to measure the latter; this is a first step towards an understanding of building obsolescence. Building depreciation, defined as a loss in the notional real existing use value of the building and not the site on which it stands, may be isolated by stripping out site factors from property-specific depreciation.

A measure of building depreciation should recognise the following.

- The notional value of a building is almost impossible to measure. There is no means of identifying it other than as a residual after site value is removed from total property value. Given that evidence of site values is rare and likely to be highly imperfect, this presents enormous problems. The solution adopted in this research is to use property value as a proxy for building value, and to remove the effect of the site by holding site value
constant. This is achieved in two ways: first, by structuring a sample of properties within a tightly defined geographical area (125 office buildings within the central City of London area and 125 industrial buildings within a single estate) within which variations in site value are likely to be small; and, second, by smoothing property values in accordance with the small variations in location value that remain.

- A loss in value is revealed as a shortfall in rental value and/or as an excess of capitalization rate against prime or best rents or yields. It may in addition be disguised by expenditure upon a building. The major research method chosen (see the following section) dictated abstracting away from the need for and effect of expenditure.

- A loss in real property value is measured by comparing the value of each building in a data sample against an average prime or best value of similar property. Existing use value is isolated by compiling a data sample free of changes in use, and changing plot ratios are excluded by measuring property value on a unit of developed space basis.

**Measurement Methods**

A loss in real property value is determined by occupiers and investors and evidenced in falling real rents and rising capitalization rates or yields, which together create falling capital value. In order to measure building depreciation as a factor in property performance, therefore, it is necessary to examine both rents and yields. Performance may then be related simply to age or to building quality. Both relationships are explored in Baum (1989). This paper concentrates on rent, the measure of value to the occupier.

Building quality is based upon the classification developed above. In order to put this classification into effect, it is necessary to relate relative performance to physical deterioration and obsolescence factors (external appearance, internal specification and configuration).

Two alternative measurement methods may be adopted. These are (i) a longitudinal analysis; and (ii) a cross-section analysis.

**Longitudinal Analysis.** A longitudinal analysis, holding site factors constant, would track the performance of a sample of buildings over time. Losses in real existing use value for each building could then be related to age and to building qualities. There are, however, several difficulties with this approach. These may be listed as follows.

- It is not possible to hold site factors constant over time. Certain sections of a location will improve while others decline due to environmental obsolescence and to shifts in supply and demand relationships. This will cloud the measurement of building depreciation. It may not be an enormous problem in certain markets, given appropriately chosen boundaries, but it will inevitably be a source of noise or distortion.

- It is difficult to find a large data sample with full evidence of rental values over a sufficiently long period.
Estimates of the quality of subject buildings in terms of external appearance, internal specification, configuration and physical deterioration factors can only be retrospective. It is therefore crucial that no changes have occurred over the measurement period, but this is unlikely, particularly given that obsolescence factors are extraneous to the subject property.

The cyclical nature of the market is another factor that may distort a measurement of building depreciation (Brown, 1986, for example, suggests this problem.) There is a suspicion that in times of high demand in the economy, and therefore high occupation demand, inferior buildings will let for as much as brand new 'state of the art' buildings, given a situation of low supply.

For these reasons a longitudinal analysis may present considerable difficulties, which suggests that the alternative, cross-section analysis, should be considered.

**Cross-Section Analysis** A cross-section analysis for the measurement of depreciation was favored in Salway (1986). Salway measured depreciation by employing the age of buildings as a proxy for all factors contributing to building depreciation, and comparing the estimated rental values of hypothetical properties at one point in time in order to keep site and tenure factors constant. This analysis provided no information about obsolescence, as no attempt was made to examine the role of age as an indicator of obsolescence.

However, that is not to say that it is impossible to measure obsolescence using Salway’s type of approach. Given a data sample of findings in a given location, it is possible to measure the impact of building depreciation upon value relative to a market prime standard by comparing relative values of different buildings and to identify the effect of obsolescence within that impact. For example, buildings identical in all aspects except for layout will differ in value: the difference is accounted for by differences in layout, and conclusions regarding the impact of layout (an obsolescence factor) upon depreciation may thereby be made.

Nevertheless, there are also difficulties with a cross-sectional measurement method.

- As values of the same building are not compared over time, and because buildings (especially offices) are largely heterogeneous, the method is less convincing as a controlled test of the depreciation of buildings. While it may be said in defence that obsolescence is ‘not directly related to... the passing of time’, differences between the buildings included in the sample inevitably reduce the validity of the test.
- The impact of site factors cannot be perfectly isolated when buildings on different sites are compared. A longitudinal study does not suffer from this problem as long as relative site factors may remain constant over time.
- In a cross-section study there is a risk that any market imbalance or peculiarity distorts more ‘normal’ patterns of depreciation (Salway, 1986). However, this may also be a problem with a longitudinal study: see above.
- A cross-section study will not reveal the sudden onset of obsolescence by, for example, technological change (Salway, 1986).
- It is impossible to examine the effect of expenditure as an indicator of depreciation within a cross-section study.
The Preferred Method of Analysis. It is suggested that both cross-section and longitudinal methods have a place in the estimation of depreciation and obsolescence and should ideally be used in tandem. Data constraints may, however, prevent the attainment of this ideal. It is stated above that depreciation may be realized in the rental value or the all-risks/initial yield of a building, and that it may be disguised by expenditure. The latter problem does not arise in the cross-section analysis; in a longitudinal analysis it has to be countered by rigorous checking of files relating to individual properties over the study period. A cross-section analysis is thereby easier to use. It is also true that data availability falls as the analysis period changes from a single cross-section point to a longitudinal time series, and as the number of observations within that series increases.

In conclusion, while both methods are useful (and both were used in the full analysis reported in Baum, 1989) use of a cross-section analysis is supported by the extra quantity and quality of the data that may be obtained, and this consideration is of overriding importance for the purposes of this paper.

The Data Sample

Following Bowie (1982) and Salway (1986) the two data sets discussed in Baum (1989) relate to office and industrial buildings. The major study described in this paper is of City of London offices. Baum (1994) discusses a minor extension of this work to shopping centres.

Data Preparation

Selection of the Database. A cross-section study is to be used as the major research method in the identification of the contribution of building obsolescence (and its causes) to depreciation in rental value. This necessitates the comparative examination of values of buildings of different ages and types at one point in time.

For reasons stated above, differences in site value are likely to complicate such a comparative examination to an unacceptable degree. It is therefore highly advantageous in constructing a data sample of actual properties to exclude the effect of site value variations both between properties of similar size and type and within the value of a particular property over time. The requirements of a statistically significant dataset are a constraint upon this, with the result that very few opportunities exist within the U.K. to collect an acceptable quantity of data within a sufficiently homogeneous (in terms of site values) location, particularly bearing in mind current requirements of confidentiality of data within the U.K. property market.

The requirements of the sample are twofold: first, to minimize differences in locational value while, second, maintaining as large a potential dataset as possible. The central part of the City of London, that is the area within a maximum radius of around one-third of a mile from the Bank of England, presents the best opportunity to achieve this in the European office markets. Consequently, a database comprising 125 office buildings, selected on the basis of familiarity to a leading U.K. real estate advisory company, was constructed for the purposes of this research.
In order to ensure that a useful and (to a limited extent) representative sample of City offices was the result of this method of data assembly, initial analyses of the data were carried out to identify inconsistencies and the study area was, as a result, redefined from the original. Inconsistencies were defined as very high or very low rental values per square foot in comparison to measured averages in the sample. The contributing surveyors were questioned about outliers of this type. If there were good reasons for such inconsistencies, the data was dropped. This happened in the case of a small number of low rental value buildings, all of which were currently the subject of renovation or refurbishment and whose current rental values were therefore artificially low. Further more formal tests were carried out, and are described in the section that follows.

It was also necessary to control the effect of varying locations within the study area, in order (i) to ensure that wide variations in locational value did not exist and (ii) to smooth away any remaining minor variations.

*Testing the Data Sample* The major research effort related to the collection of rental data. For every property in the database, a panel of three surveyors familiar with the study area was asked to produce a consensus view of the then current rental value per square foot per annum on the assumption that a good quality tenant would be taking a typical new lease of a 10,000 square foot unit within the building, as far as this was possible or appropriate. This achieved several purposes: among them, the fact that the rental opinion was based on a typical U.K. (twenty-five with five year reviews, full repairing and insuring) new lease excluded any distorting effects that might arise because of the unique circumstances and qualities of an actual tenant or lease contract. Also the presumption of a 10,000 square foot unit negates the effect of property size as a determinant of rental value. Differences in rental value can then be ascribed to physical qualities.

Those physical qualities likely to be most important were determined from a full list of possibilities by a brainstorming exercise in which four briefed letting agents arrived at a consensus view. Those identified qualities were used in developing the classification of depreciation and obsolescence presented earlier. The final choice, constrained to a list of five, was configuration of space, external appearance, internal specification and physical deterioration, plus siting.

The three surveyors who made up the valuation panel included two letting agents and a rent review specialist. The involvement of the latter acted as a moderating influence in the assessment of both rental value and building qualities (see below). Rental values were estimated by the panel in a single interview meeting. The panel were shown photographs of the 125 buildings and were given details of age, if and when refurbished, whether air-conditioned, and full addresses. Every building was familiar to at least one member of the panel.

The panel was asked to estimate the rental value that would be currently attainable in the market given a reasonable marketing delay and subject to all the qualifications noted above. All panel members had prepared valuations in advance of the discussion. Where valuations differed (and this was not uncommon, although the degree of variation was usually within 5%) a consensus view was arrived at by discussion in every case.

This data is not a measure of the market price of City office space, and to that
extent it is flawed. However, actual letting values could not be of use as the basis of research such as this for two reasons. Firstly, the number of lettings in such a tightly defined area in a reasonably closely defined time period is extremely small. A reasonable but unscientific estimate made at the time of the research was that no more than 5% of the sample had been the subject of an open market letting that year. Secondly, most open market lettings are colored in some way: by existing relationships between the landlord and tenant, by the payment of premiums, by variations in repairing terms, and by variations in other lease terms.

If there is any bias in these opinions, this is not of importance as long as the bias is consistent. A bias is possible because letting agents would be expected to be optimistic; but inconsistency is unlikely, given that knowledge of the probable behaviour of tenants and potential tenants is very highly developed among letting agents. Consequently, while the opinions of letting agents cannot be guaranteed as a perfect proxy for the opinions and behavior of tenants (and potential tenants), the fit would be expected to be very good.

Consistency In order to check the consistency of the sample (in other words, to identify data that is defective an/or unrepresentative), age was initially related to rental value. The expectation (following Salway, 1986) was of a noticeable negative correlation. However, too high a correlation coefficient (say above .8) might invalidate the hypothesis of this research, namely that building quality is a more meaningful predictor or determinant of rental value than simple age. Too low a correlation coefficient (say below .4) on the other hand might suggest an unrepresentative or otherwise defective data sample, given the intuitively held belief that older buildings are worth less, ceteris paribus, than new ones.

However, it is clear that in relating building age to rental value there is a cut-off point in terms of age beyond which meaningless results will be obtained. For example, there may be no difference between the rental values of 1820 and 1890 buildings, but the difference in age is great. To cope with the problem a cut-off rate of thirty-five years was used, and any building constructed prior to 1950 is given a dummy age of thirty-five years. (This affects the degree to which the distribution is normal, a problem that limits the usefulness of certain statistical measures.)

Furthermore, where a property had been substantially refurbished, it would be incorrect to relate the age of the original construction to rental value. For example, a period property (dummy age thirty-five) that has been redeveloped behind the existing facade would command a substantially higher rent than an original building of the same, or even a lower, age. Rental value was therefore related to building age, or where relevant, the period since a major refurbishment, whichever is the lower value.

Exhibit 3 shows that age is a reasonable indicator of rental value. The variables of age and rental value are negatively correlated, as expected. A correlation coefficient of -.588 is acceptable, and the coefficient of determination of 34.4% states that age is only a fair indicator of rental value while raising no serious doubts about the adequacy of the data sample. It was felt that this provided a promising foundation for the research.

Location The effect of location had also to be tested in order to establish that the degree of variation in site values fell within an acceptably narrow range. In addition,
Exhibit 3
Relationship of Rental Value and Age: All Properties (Offices)

<table>
<thead>
<tr>
<th>Number of datapoints:</th>
<th>126</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age:</td>
<td>9.62 years</td>
</tr>
<tr>
<td>Standard deviation of age:</td>
<td>9.65 years</td>
</tr>
<tr>
<td>Mean estimated rental value (ERV):</td>
<td>£30.75 pa</td>
</tr>
<tr>
<td>Standard deviation of ERV:</td>
<td>£5.30 pa</td>
</tr>
<tr>
<td>Correlation coefficient (r):</td>
<td>-0.588</td>
</tr>
<tr>
<td>Regression equation:</td>
<td>$ERV = £36.20 - 0.322 age$</td>
</tr>
<tr>
<td>Coefficient of determination of regression equation ($R^2$):</td>
<td>34.4%</td>
</tr>
<tr>
<td>Significance (t):</td>
<td>8.83</td>
</tr>
</tbody>
</table>

Note: ERV means estimated (appraised) rental value.

It was not desirable to allow major variations in land values to remain within the database when the purpose of the exercise was to create a homogeneous (in terms of site values) sample. On the other hand, it would be impossible to construct a database with no variation in site values.

To ensure that the site effect was kept to a minimum, the following test was carried out. As part of the main data-gathering exercise, each property in the sample was assigned a score of 1 to 5 by the valuation panel to represent low or high quality respectively in terms of the following definitions: ‘neighbors, sitting and immediate environs, including accessibility, frontage, floor level (where appropriate), and adjoining uses, but excluding wider location factors’. This recognized the fact that, even within a homogeneous site value area, specific location-related factors cannot be removed from the list of valuable features of a building. It also provided the opportunity to ensure that site value variations resulting from wider location considerations did not color the sample.

A high quality building derived from the sample, with a site score of 5, was hypothetically ‘placed’ at twenty-one of the different locations within the database and a rental value estimate made by the panel. The result was a minimum value of £35 per square foot per annum and a maximum value of £41 per square foot per annum, a variation of 14.6% on the higher value. The differences in rental value led to the exclusion of some low value outlying locations and their replacement by central properties. What remained was a range from £35.75 to £41 (slightly over 12%) and a high correlation ($r = .811$) between site score and rental value.

This test suggested two things: first, that the degree of variation was within reasonable limits; and second, that wider location factors (for example, the possibility of the western part of the study area being preferred to the eastern part) were of little impact in influencing rental value. A coefficient of determination ($R^2$) of 66% (see Exhibit 4) suggests that two-thirds of variations in site values are explained by the specific location factors listed above (neighbors, sitting and immediate environs, and so on). The remaining one-third falls to be divided between wider location factors and sample error. It is therefore realistic to conclude that wider location factors, defined as differences in site value between different parts of the study area, unconstrained by existing developments and occupation, are not of major impact in the sample.
Exhibit 4

Relationship of Site Score and ERV (Offices)

<table>
<thead>
<tr>
<th>Site Score</th>
<th>ERV (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>40.0</td>
</tr>
<tr>
<td>4</td>
<td>38.0</td>
</tr>
<tr>
<td>3</td>
<td>38.0</td>
</tr>
<tr>
<td>2</td>
<td>36.5</td>
</tr>
</tbody>
</table>

Regression equation: \( ERV = 33.79 + (1.27 \times \text{site score}) \)
Coefficient of determination of regression equation \( R^2 = 65.77\% \)
Significance \( t = 6.71 \)

Smoothing the Data Sample

Differences in site value complicate a comparative examination of values of buildings of different ages and types both at one point in time and over time. It is therefore necessary to exclude the effect of site variations from the sample of rental values. From the twenty-one rent points taken the average rental value for different site scores can be computed. As rounded, these are as shown in Exhibit 5.

From these averages, weightings are computed as shown in Exhibit 6. These weightings were then applied to all 125 datapoints. The result is that two-thirds of value variations caused by site are smoothed away from the dataset, as all buildings are effectively assumed to occupy a high quality site.

Exhibit 5

Site Scores and Average ERV (Offices)

<table>
<thead>
<tr>
<th>Site Score</th>
<th>Average ERV (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>£35.75</td>
</tr>
<tr>
<td>3</td>
<td>£37.75</td>
</tr>
<tr>
<td>4</td>
<td>£38.50</td>
</tr>
<tr>
<td>5</td>
<td>£40.25</td>
</tr>
</tbody>
</table>

Note: No property was allocated a site score of 1

Exhibit 6

Site Smoothing Factors (Offices)

<table>
<thead>
<tr>
<th>Site Score</th>
<th>Smoothing Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>£40.25/£35.75 = 1.1259</td>
</tr>
<tr>
<td>3</td>
<td>£40.25/£37.75 = 1.0662</td>
</tr>
<tr>
<td>4</td>
<td>£40.25/£38.50 = 1.0455</td>
</tr>
<tr>
<td>5</td>
<td>£40.25/£40.25 = 1.0000</td>
</tr>
</tbody>
</table>
The available data, therefore, is based upon the rental value of a sample of 125 central City office buildings, with most site value variations smoothed away and with major inconsistencies in the data sample tested for and (where necessary) removed. It has also to include appraisals of building qualities, which are described immediately below.

**Appraisals**

*Rental Value and Age Data*  The data available so far can be summarized as follows:

- the smoothed rental value per annum of 10,000 square feet of space in the subject property let on a new twenty-five-year lease with five-yearly reviews to a good quality tenant with no unusual lease terms, as at August 1986; and
- the age of the sample properties or the period since a major refurbishment was carried out.

This data facilitated the initial testing of the sample for inconsistency and any apparent problems and allowed the smoothing away of variations in value resulting from different siting.

*Building Qualities Data*  Given that the definition of building depreciation for the purpose of this paper is a loss in the real existing use value of a property investment, then any shortfalls in value against a prime index can be attributed to building depreciation. The prime index is represented by a rent of £40.25, the average rent for a prime building with a site score of 5 (an excellent site); shortfalls are represented by the difference between this figure and the actual smoothed rental values of the 125 buildings in the sample.

The shortfall in each case is caused by building depreciation resulting from differences in building quality. In order to relate the shortfall to building quality it is necessary to measure the latter.

Two root qualities, physical deterioration and building obsolescence, are identified in Exhibit 1. It may have been possible to grade each building in the sample in terms of these twin factors. However, while physical deterioration of both internal and external building components can easily be scored in this way, building obsolescence is a highly complex factor that would create enormous difficulties. At the very minimum, it was considered necessary to subdivide building obsolescence into three distinct factors, as shown in Exhibit 1, each independent of the additional effect on physical deterioration. The three obsolescence factors are therefore:

- the external appearance of the building, combining external design and the impact of the entrance, and so on, but ignoring the effect of physical deterioration upon this;
- the internal specification, combining internal finishes and services but excluding the effect of physical deterioration upon each; and
- configuration, combining floor to ceiling heights and floor layout, upon which physical deterioration has no effect.
Building quality and hence building depreciation can therefore be measured by assessing each building in terms of four major factors:

- physical deterioration of both interior and exterior;
- external appearance (external design and impact of entrance, and so on) ignoring the effect of physical deterioration;
- internal specification (internal finishes and services) ignoring the effect of physical deterioration; and
- configuration (floor-to-ceiling height and floor layout).

The selection of these factors was firstly confirmed as acceptable by discussion with the panel of valuers. The measurement of these factors was achieved by repeating the method employed to check site quality. The panel of three valuers, each highly familiar with the study location, was asked to produce, during four three-hour sessions, a consensus view of the quality of each of the following 125 buildings in terms of the above four factors. A scale of 1 to 5 was again used, with the following implications.

1. Poor (in terms of physical deterioration, this means highly deteriorated)
2. Mediocre
3. Average
4. Good
5. Excellent (in terms of physical deterioration, this means a brand new building or equivalent)

Data Analysis

Introduction

This section describes the analysis of the major dataset and the collection and analysis of further data as both a check upon, and as an expansion of, the main analysis. It falls into two parts: (i) a cross-section analysis of rental values, relating depreciation in rental values, first to age and second, to a set of building quality variables; and (ii) a description and analysis of an occupier survey.

Methodology

The methodology employed in data analysis is a combination of statistical and hierarchical approaches. The reasons for this amalgamation of techniques are introduced above and further developed below.

The basic statistical technique used is multiple regression analysis. This is made less complex than it might otherwise be by an assumption of linear relationships existing between the data, allowing linear regression techniques to be used. Greaves (1985) considered and measured the determinants of residential property values using a similar approach, combining hierarchical and statistical (multiple regression) techniques. An extract from his paper explains the reasons for his choice:
In a multiple regression model the analyst may be content to predict values. In this case he can go on adding variables to the equation to obtain the highest predictive power (denoted by $R^2$) without regard to how each variable's contribution is altered by each successive addition. The total contribution of all the variables is then important but the contribution of each one is not. The equation thus formed can be difficult to interpret since the importance it gives to the variables may not coincide with the valuer's experience of the way in which the variables behave. For instance we may know that a variable such as size of plot or built-up area should have a positive sign, since values would increase as they became larger. The equation could well show such variables with a negative sign suggesting the opposite, and this could be very disquieting . . .

A statistical approach indicates the relative importance of each variable by its order of entry into the equation. However, if multicollinearity is present to any extent in the sample, the statistical order of entry and hence the relative importance of each variable may not agree with that as seen by the hierarchical approach, which is based on the population. For this reason, if the analyst wishes to explain as well as predict values the selection of variables by a statistical approach may be inadequate. It should, therefore, be used as a check on the hierarchical approach if strong reasons exist to support the latter.

. . . a simple approach is necessary as a start and a logical starting point must be the market place. The analyst should initially try to elicit from the consuming public, by a set of discerning and properly structured questions, the factors they are willing to pay for and in what order of priority they are placed. (p. 11)

Greaves distinguishes statistical approaches (the basis of the analysis described above) from hierarchical approaches by making the point that a multiple regression model may throw out a different ranking of variables from that which is consciously part of the decision process followed by consumers. If the research were to ignore a hierarchical approach, it is possible that the conclusions of the research in respect of the relative importance of building qualities may be incorrect.

The prime motivation of the empirical research described in this paper is the explanation of depreciation; this aim is not served by a purely statistical approach, nor by the construction of multiple regression models with a large number of independent variables that are needed to support high coefficients of determination.

Additionally, it is expected that multicollinearity will affect the multiple regression analysis. Coefficients cannot therefore be relied upon as relative measures of the importance of individual variables. The sign of coefficients may even be reversed, so that the intuitive may not equate with the statistical effect of a particular variable.

The problem of potential divergence between hierarchical and statistical results becomes greater as the number of independent variables increases and with the degree of correlation between them. In this research, degrees of correlation are high. It is therefore helpful to impose a limit on the number of independent variables by using a hierarchical approach in their selection.
These considerations have guided the choice of methodology. A hierarchical approach is first used to select variables. This combines a search of published material and a panel consensus. It is also checked by a survey of occupiers (below). Regression models are then used to describe the relationship between age and ERV and between the four building qualities and ERV. The four-variable building quality equations may then be adjusted by removing variables, both to reduce problems of multicollinearity and to build a useful framework for prediction.

Cross-Section Rent Analysis

Age against Depreciation in ERV  Exhibit 3 shows the results of a comparison of age and smoothed depreciation in estimated rental value (ERV) at August 1986. The more depreciated is the building, the lower is its rent. Following Salway (1986) older buildings let for less. Hence depreciation in ERV and age are positively correlated, as Exhibit 3 confirms. The results are highly significant at the 95% level showing that the result is not likely to be the result of chance; but only 38% of depreciation is explained by age, so other factors are clearly of importance.

Exhibit 7 presents a clearer picture of the uneven pattern of rental depreciation connected with the aging process. This shows high depreciation for years 17 to 26 (mean ages for each respective age band) for the whole sample.

Building Qualities against Depreciation in ERV  Age was thus found to be a useful, but imperfect, explanation of building depreciation. Building quality is now examined as a possible improvement upon this.

Depreciation is defined as the difference between the smoothed ERV of each property in the sample and the prime rent of £40.25. In order to test the relationship between building qualities and depreciation in ERV, the resulting depreciation figure in each case is compared with the shortfall in each of four building qualities against a

| Exhibit 7 |
| Depreciation in ERV and Age Band (sample: 125) |

<table>
<thead>
<tr>
<th>Age</th>
<th>Frequency</th>
<th>Mean Age</th>
<th>Average Smoothed ERV (£)</th>
<th>Index</th>
<th>Dep'n pa (%)</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>48</td>
<td>1.94</td>
<td>34.76</td>
<td>100.00</td>
<td>.977</td>
<td>2-7</td>
</tr>
<tr>
<td>5-9</td>
<td>31</td>
<td>6.77</td>
<td>33.12</td>
<td>95.28</td>
<td>.616</td>
<td>7-11</td>
</tr>
<tr>
<td>10-14</td>
<td>19</td>
<td>11.26</td>
<td>32.16</td>
<td>92.52</td>
<td>.496</td>
<td>11-17</td>
</tr>
<tr>
<td>15-19</td>
<td>10</td>
<td>16.70</td>
<td>31.22</td>
<td>89.82</td>
<td>1.785</td>
<td>17-26</td>
</tr>
<tr>
<td>30+</td>
<td>9</td>
<td>34.44</td>
<td>24.40</td>
<td>70.20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mean annual depreciation rate: .92%
Exhibit 8
Depreciation and Building Qualities
(sample: 125)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Correlation Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal specification</td>
<td>.794</td>
</tr>
<tr>
<td>Physical deterioration</td>
<td>.741</td>
</tr>
<tr>
<td>Configuration</td>
<td>.702</td>
</tr>
<tr>
<td>External appearance</td>
<td>.693</td>
</tr>
</tbody>
</table>

prime score of 5, based on the hypothesis that a prime building scoring 5 in each of the four categories (physical deterioration, internal specification, external appearance and configuration) will let at a prime rent, once site effect is smoothed away. A positive relationship should therefore exist between depreciation and the shortfall in building quality score in each case.

The relationship is expressed in terms of the dependent variable (depreciation, that is £40.25 minus the smoothed ERV) and the independent variable (shortfall in the relevant building quality, that is 5 minus the relevant score), and is measured initially by means of the individual correlation coefficient. Results are shown in Exhibit 8.

The correlations are all high. Note that the correlation coefficient relating the independent variable (age) and the dependent variable (depreciation) was .623; it is therefore to be concluded that any one of the building qualities noted above is a stronger determinant of depreciation than age.

It is dangerous to conclude which is the most important building quality from these results because of multicollinearity between the independent variables. For example, while there may be a high correlation between depreciation and physical deterioration, it may be incorrect to conclude that deterioration is important as a cause of depreciation. It may be that buildings subject to high deterioration are also likely to suffer from a poor internal specification, so that internal specification is therefore highly correlated with physical deterioration, and that internal specification is a very important predictor of depreciation. Physical deterioration will therefore be strongly correlated with depreciation but only as a result of the indirect link via internal specification. Again, poor configuration may lead to less expenditure to address physical deterioration, and the relative importance of these qualities may thereby be disguised.

This suggests very high multicollinearity of variables (measured and reported in Baum, 1989). This is the result either of the existence of 'good' and 'bad' buildings, or of a failure of the research to adequately distinguish between qualities. Whichever is the case, it produces problems when using statistical techniques to rank building qualities.

Such a means of ranking building qualities is presented by multiple regression analysis. It is possible to use this method to construct an equation which relates the dependent variable (depreciation) to the four variables. It is then possible to compare the relative importance in the equation of each of the four variables.
A multiple regression model is an explanatory model, as its purpose is to identify those factors which have impacted the most on the dependent variable. Greater explanatory power will be produced by adding further variables, but this is at the cost of multicollinearity and less ease of use. In addition, the model may form the basis of a predictive model which, given information about the value of independent variables, will estimate the value of the dependent variables.

Given this, the model needs to be efficient. Efficiency (not used with its strict econometric meaning) for these purposes means a combination of accuracy and explanatory power (a high coefficient of determination, or $\bar{R}^2$), and a low number of significant independent variables.

The initial multiple regression equation is as shown in equation 7. The value of the constant in this equation, \(-0.0658\) (just over six pennies) is effectively a measure of error in this equation, or at least of 'noise', or imperfect data. The value of the constant should ideally be zero, because nil depreciation should be predicted for a building scoring 5 in all four building qualities. In such a case, the values of $a_1$, $a_2$, $a_3$ and $a_4$ would be zero, and the constant represents the total value of the right-hand side.

Nonetheless, a constant of 0.0658 against a prime ERV of £40.25 represents a variation (from the 'correct' value) of only 0.16%, and can therefore be regarded as a satisfactory result. It is not significantly different from zero.

Equation 7, which shows total depreciation in ERV, all buildings (sample: 125), is

\[
\text{Total depreciation in ERV} = 0.0658 + 0.199a_1 + 0.213a_2 + 0.154a_3 + 0.103a_4, \tag{7}
\]

where

- $a_1$ = 5-configuration score, and $t = 3.93$,
- $a_2$ = 5-internal specification score, and $t = 3.86$,
- $a_3$ = 5-external appearance score, and $t = 3.82$,
- $a_4$ = 5-physical deterioration score, and $t = 2.01$.

$\bar{R}^2 = 73.0\%$

The shortfall in rent is related to the shortfall in quality, which leads to an expectation of positive relationships, and again the result is satisfactory because all signs are as intuitively expected. Depreciation is positively related with the shortfall in score of each variable: thus the lower the score, the greater the depreciation, as expected. The coefficient of determination is 73%, which is superior to the 39% explanatory power of age as an explanation of depreciation, supporting a major hypothesis in this research.

Of equal interest is the relative importance of each variable. A $t$-test measures significance at stated confidence levels. At the 95% level (that is, with a 5% chance that the result is accidental), a $t$-value of 1.96 is acceptable and this test therefore shows all four variables to be significant at that level of confidence. Judgements of relative importance therefore rest upon the constant or coefficient for each variable. Given that the constant is close to zero as expected, a building with a score of 5 for each variable would suffer negligible or no depreciation. Of the four variables, internal
specification is most important at .213; configuration is second at .199; external appearance is third at .154; and physical deterioration is least important at .103.

This produces an important preliminary conclusion. Of the twin causes of building depreciation, building obsolescence (as represented by shortfalls in internal specification, external appearance and configuration) appears to be much more important than physical deterioration. Investment decisions might therefore pay little attention to anticipated physical deterioration; building obsolescence is much more important. Given that building obsolescence by its very nature (it is not directly related to use, the action of the elements or the passage of time) is difficult or impossible to predict, flexibility in terms of internal specification, external appearance and configuration is to be aimed for.

A Survey of Occupiers

Introduction Several criticisms of this analysis may perhaps be made. To begin with, the choice of four building qualities and siting as the predominant factors affecting rental value, albeit the result of a brainstorming session conducted by the researchers with the participation of four previously briefed and prepared expert City office agents, may be said to be subjective to those agents and not necessarily representative of the views of the office occupiers and intending office occupiers they purport to simulate. Consequently the research may be flawed as it fails to relate depreciation to the building qualities that are really important in the market.

Next, given the problems of multicollinearity that inevitably exist in a study of this type, can the researchers be sure that the ranking of importance of building qualities thrown out by multiple regression analysis reflects the importance assigned to those variables by occupiers? Alternatively, are the results statistically significant but practically misleading?

A third possible problem is the potential charge that the analysis is not sufficiently wide. It is beyond question that further research is necessary to explore the subfactors that together make up deterioration and obsolescence. For example, it may be useful to know that internal specification is the most important factor in terms of causes of rental depreciation, but what are the most important factors within internal specification?

To begin to address these issues, a survey of 316 occupiers of the 125 buildings in the data sample was carried out. The response rate was average, around 25% of those questioned returning correctly completed forms. The data sample is eighty respondents, a number that is arguably acceptable for the purposes of analysis.

Choice of Building Qualities Few occupiers chose to list extra factors. Those that were mentioned were merely subfactors of the five qualities. For example, 'raised access floors,' 'symmetrical building configuration,' 'raised modular floors,' 'large open floor' and 'constructional suitability for dealing room environment' were quoted, but all fall within the configuration quality. Similarly, 'good adaptable services,' '24-hour air-conditioning' and 'air-conditioning independent to each floor' stated by some respondents all fall within the quality of internal specification. 'Proximity to markets/ associated business/professional advisers' were all seen as important, but are siting factors, excluded from the analysis.
Given these results it is concluded that the use of the original five factors in the analysis does not omit any important factors as perceived in the market for City office space, and the agents' choice of variables was a correct reflection of occupiers' preferences and priorities. No modification of the original research method was therefore necessary.

**Ranking of Building Qualities** Occupiers of the subject properties were asked to rank the importance of the four building qualities using a scale of 1 to 5. A score of 1 was awarded for high importance. The building quality with the lowest total score is therefore the most important to the sample of eighty occupiers.

Results are shown in Exhibit 9 and confirm the ordering produced by multiple regression analysis with the exception of the reversal in importance of configuration and internal specification. These two factors are clearly ahead in both tests, the reversal is not problematic, and statistical and hierarchical ordering approaches can be said to be broadly consistent in this case.

This may be regarded as a significant confirmation of the results of the cross-section analysis described above. Internal specification and configuration are of superior importance in determining rental depreciation; physical deterioration is least important.

<table>
<thead>
<tr>
<th>Quality</th>
<th>Total Score</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
<td>191.0</td>
<td>1</td>
</tr>
<tr>
<td>Internal specification</td>
<td>236.5</td>
<td>2</td>
</tr>
<tr>
<td>External appearance</td>
<td>289.5</td>
<td>3</td>
</tr>
<tr>
<td>Deterioration</td>
<td>299.0</td>
<td>4</td>
</tr>
</tbody>
</table>

**Building Qualities: An Analysis of Subfactors** In order to explore further the importance of building qualities in determining rental value, and hence depreciation in rental value, an attempt was made to proceed to a second level of building quality analysis. Exhibit 2 shows that the three obsolescence factors may be further broken down into two subfactors each. Deterioration may also be split into interior and exterior deterioration.

Occupiers of the subject buildings were asked to indicate which of the two subfactors within each quality was the most important. Exhibit 10 shows clear preferences in each category.

**Occupiers' Appraisals** Occupiers were also asked to rate the quality of their space on a scale of 1 to 5 in terms of the four building qualities and sitting in order that the appraisals of the valuation panel might be compared with the occupiers' own appraisals. For individual buildings there were many disagreements; on average, they were insignificant. The results show occupiers to be consistently more positive, as
Exhibit 10

Importance of Building Subfactors

<table>
<thead>
<tr>
<th>Factor</th>
<th>Subfactor</th>
<th>Rating</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration</td>
<td>Floor layout</td>
<td>51</td>
<td>(86.4%)</td>
</tr>
<tr>
<td></td>
<td>Floor-to-ceiling height</td>
<td>8</td>
<td>(13.6%)</td>
</tr>
<tr>
<td>Internal</td>
<td>Quantity/quality of services</td>
<td>47</td>
<td>(79.7%)</td>
</tr>
<tr>
<td>specification</td>
<td>Quality of finishes</td>
<td>12</td>
<td>(20.3%)</td>
</tr>
<tr>
<td>External</td>
<td>Impact of entrance hall, etc.</td>
<td>44</td>
<td>(72.1%)</td>
</tr>
<tr>
<td>appearance</td>
<td>Quality of external design</td>
<td>17</td>
<td>(27.9%)</td>
</tr>
<tr>
<td>Deterioration</td>
<td>Deterioration of interior</td>
<td>41</td>
<td>(65.1%)</td>
</tr>
<tr>
<td></td>
<td>Deterioration of exterior</td>
<td>22</td>
<td>(34.9%)</td>
</tr>
</tbody>
</table>

would be expected from those who have a subjective interest against those forming an objective comparative view.

Valuers acting as proxies for occupiers exhibit a bias. However, because that bias appears to be consistent with the views of occupiers, the agents' appraisals, being relative, can be taken as indicative of the market view.

Conclusions

There are many ways in which quality can be defined for real estate. This paper demonstrates the uses of a classification of building quality (as opposed to locational quality) defined with particular reference to occupier utility.

First, it is clear that age is related to this definition of quality. Buildings deteriorate and become obsolete as they age. However, some depreciate more quickly than others. The depreciation rate is a function of age but also of building quality or qualities.

By measuring building depreciation and developing a classification of building qualities, it was possible to relate qualities to depreciation in order to prove that a stronger and more meaningful relationship exists between quality and depreciation than that which exists between age and depreciation. It is also clear that the obsolescence factors, especially configuration and internal specification, are more important in this respect than deterioration factors. This was established by means of intensive questioning of real estate professionals and backed by a survey of occupiers.

The survey of occupiers was particularly important in three respects. First, it gave support to the selection of building qualities that appear to have been correctly determined by professionals and to have reflected the views of the occupier market. Second, the ranking of qualities as predictors of depreciation was confirmed: deterioration is least important and internal specification and configuration are most important. External appearance was disappointingly unimportant for London office occupiers. Hence a hierarchical approach confirmed the statistical approach. Third, a further analysis of subfactors of the four qualities shows clear results, especially the predominance of layout over floor to ceiling height in the configuration factor and the importance of services in internal specification.
It also appears that there is a relationship between quality and return. Further work (see Baum, 1989) suggests that pricing does not efficiently reflect these factors. Occupiers' preferences can probably be built into design without necessarily impacting on cost to an equal and opposite degree; investment returns will then be delivered, inter alia, by the resistance of rental values to depreciation.

References