The Causes and Effects of Depreciation in Office Buildings: a Ten Year Update

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There are good reasons for expecting that depreciation has become now more important as a driver of property investment performance. The pace of technological change and lower central London land values each suggest that the contribution of the building component of property value is likely to decline as a proportion of property value at a more rapid rate. This would damage the capital return on central London offices. Unless real rental growth or inflation is high, this depreciation damage will become more transparent.

A 1986 study, published in full in Baum (1991), established a data set, a methodology for the measurement of depreciation (and its contributing causes), and a set of results for the City office market as it entered a phase of rapid rental growth. An updated but similar dataset and the same methodology has now been used to re-estimate (in mid-1996) the incidence of depreciation in what has been a lower growth, lower inflation environment.

This paper publishes the results of the 1996 study, which repeats a cross-section analysis of around 125 City office buildings, adds a similar sample of West End offices, and examines the longitudinal data contributed by a sample of 56 unrefurbished properties common to the 1986 and 1996 City datasets. An estimate of the average rate of rental and capital value depreciation is made; the effect of age is shown not to be straight-line; and the causes if depreciation are measured. The results are compared with the 1986 City findings.

Further, it is suggested that the empirical evidence supports the intuitive suggestion that as buildings age the contribution of building value to property value tends to zero and depreciation thereby disappears. Finally, it is suggested that the pricing of central London offices may fail to recognise this effect.

1. Introduction

In 1996, Lambert Smith Hampton and Henderson Real Estate Strategy supported a study of office depreciation in the City and West End areas of central London. The analysis was undertaken by Andrew Baum and Anita McElhinney at HRES, supported by Paul Richards and a team of surveyors at LSH. This research is based on and developed from the original survey of the City office market undertaken by Baum in 1986.

2. What Is Depreciation?

Buildings, unlike many other forms of investment, suffer from deterioration and obsolescence. As they age, they become less valuable than equivalent new buildings as a result of wear and tear and changes in technology.

Depreciation itself is a loss in the existing value of the property. It can be caused by physical deterioration or by functional or aesthetic obsolescence. Whilst obsolescence is one cause of depreciation, such a decline in utility is not directly related to physical usage or the passage of time (Baum, 1991).

This study attempts to measure the effects of both physical deterioration and obsolescence over time and as a function of selected building qualiites. It examines the impact of depreciation as manifested in its impact on rental values, yields and (as a product) and capital values. It begins by establishing a model which allows for the impact of depreciation in property pricing.

3. The Importance Of Depreciation In Investment

In a low inflation, low growth environment depreciation is a crucial factor in property investment. It is fundamental because it forms a basic input for any pricing or valuation model.

Depreciation estimates are required for two purposes. Assuming a DCF model is used for valuation over a finite holding period, an estimate of rental values is needed for the purpose of estimating cash flows and rental value on reversion, and the long term depreciation rate feeds into exit yields.

The basis of a valuation model and exit yield computation lies in two simple equations developed by Fisher (Fisher, 1930) and Gordon (Gordon, 1962) and further developed by Baum (Baum, 1988; Baum and MacGregor, 1992) which explain respectively the total return required on an investment and the relationship between total required return and initial return. This begins with the Fisher equation.

3.1 The (simplified) Fisher equation

$$\mathbf{e = p + i + r} \quad (1)$$

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 index-linked gilts is given by p; the required return on 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 re-written as

$$\mathbf{e = RFR + r} \quad (2)$$

where: **RFR** is a nominal risk free rate (conventional gilts, treasury bills)
r is the reward for risk, called a risk premium

3.2 Gordon's growth model

$$\mathbf{k = e - g} \quad (3)$$

where: **k** = initial yield from an investment
e = total return required from an investment
g = annual expected growth in income

Re-arranging:

$$e = k + g \quad \text{(Gordon)}$$

$$e = RFR + r \quad \text{(Fisher)}$$

So: $$\mathbf{RFR + r = k + g} \quad (4)$$

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 re-arranged as follows:

$$\mathbf{k = RFR + r - g} \quad (5)$$

3.3 Depreciation

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

First, the simplifying assumption of the model is that income is received annually in arrears, with dividends increasing from year to year as company profits improve. This is not strictly appropriate for equities, as dividends are received twice yearly, but the error is very small. For 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 largely 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 re-generate themselves.

Buildings depreciate through physical deterioration and obsolescence. Expected growth in income is calculated gross of this (usually by econometric modelling or extrapolation of undepreciated rent indices) so it needs to be taken into account.

Thus: $$\mathbf{RFR + r = k + g - d}$$

meaning 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 into perpetuity.

3.4 Correct yields

The 'correct yield' for a property may be estimated based on the market correctly discounting long term market expectations of real rental growth, depreciation and inflation. For this purpose, it is important to calculate the average rate of depreciation into perpetuity.

$$\mathbf{RFR + r = k + g - d}$$

So: $$\mathbf{k = RFR + r - g + d}$$

If depreciation rates vary with age, the long term depreciation expectation will rise and fall as a building ages: in this case the correct yield will be age-dependent. Yields are generally expected to rise with age: this clearly need not be the case if depreciation rates do not also rise with age.

4. The 1986 Survey

In 1986 one of the authors, then working at what is now the City University Business School, undertook a research project sponsored by Richard Ellis and Hill Samuel which attempted to measure, for the first time, rates of depreciation in rental value and capital value for portfolios of UK property. The samples used were 125 offices in the City of London and 125 industrials on a large industrial estate. The results were published in various formats (Baum, 1988, 1989, 1991 and 1993).

The most convincing work was achieved with the City office sample. This work was of the greater general interest, if only because offices comprised and comprise more than 45 per cent of the UK commercial property market (as measured by IPD) while industrials cover only slightly more than 10 per cent.

For various reasons of data quality, it was decided that a cross-section studies was to be used as the major research method in the identification of the contribution of building obsolescence (and its causes) to depreciation. This necessitates the comparative examination of values of buildings of different ages and types at one point in time. Hence at one point in time (July 1986) a slice of the City office market was sampled, and variations between buildings, rather than within buildings over time, were used to measure the impact of different factors on value.

Data was collected primarily from Richard Ellis to furnish a cross-section analysis of rental value, yield (capitalisation rate) and capital value in terms of building age and building quality.

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 between properties of similar size and type. The requirements of a statistically significant data set are a constraint upon this, with the result that very few opportunities exist within the UK 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 UK property market.

The requirements of the sample are two-fold: firstly, to minimise differences in locational value while, secondly, maintaining as large a potential data set 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 an opportunity to achieve this.

The database comprises 125 office buildings, largely selected on the basis of familiarity to surveyors in the City office of Richard Ellis and/or inclusion in the RICS/Actuaries Rent Index (now defunct). This skewed the sample towards larger, more valuable and more prominent properties. Despite this, the properties include examples of both refurbishments and original (that is non-refurbished) buildings, air-conditioned and non air-conditioned offices and a wide range of ages and styles.

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, re-defined 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. 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 (see Baum, 1991). 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.

A full description of the data preparation process is provided in Baum (1991).

5. The 1986 Results

The main findings of the 1986 City office research were as follows.

For all City office properties in the sample, the annual rate of depreciation in rental value over the first 35 years of life averaged 1.1 per cent. The period of greatest depreciation in rental values was years 17 to 26, where the annual rate of depreciation reached 1.8 per cent.

The annual rate of depreciation in capital values averaged 1.6 per cent. The period of greatest depreciation in capital values was years 20 to 29, where the annual rate of depreciation reached 2.1 per cent.

By examining the potential impact of refurbishment on rental value, depreciation was separated into curable and incurable components. These were found to be of equal weight.

Building quality, defined as a combination of obsolescence-related factors (configuration, internal specification and external appearance) and physical deterioration, was found to be a better explanation of rental value (and depreciation in rental value) than simple age.

The most significant and important determinant of depreciation in rental value was found to be configuration, followed by internal specification. Physical deterioration was found to be least important. For explaining depreciation in capital value, internal specification and external appearance were most important; deterioration was again least important.

Internal specification was found to be the most significant determinant of curable depreciation in rental value; configuration was found to be the most significant determinant of incurable depreciation in rental value.

6. The 1996 Survey: The Background

1986 was an interesting year for the central London office market. Following several years of under-performance, especially relative to retail property, 1986 was the year the City market recovered in the face of Big Bang and the demand for large open floors of dealing space. The West End market, hitherto cheaper than the City, followed after and by the end of the decade had surpassed City values. As a result, offices were the best performing properties in 1986 (just) and 1987 (clearly) for the first time since 1973.

1996 was an equally interesting year. Offices had under-performed the market every year since 1989. In 1996, offices did not perform particularly well relative to industrials and retail, but 1996 was the first year of positive rental growth in the office market since 1989, and this again suggested a turning point.

6.1 Selection of the dataset: City

The collection exercise began with the APR stock database of 536 buildings, generally the more prominent office properties in the City. This was to be reduced to a target size of 125 by a process which had the following objectives in mind:

(i) to update the sample, in order that it included new properties of size and importance and thereby retained a sample truly representative of the prime end of the City office market;

(ii) to maintain a lower size limit of 10,000 square feet;

(iii) to attain a representative sample by age band since construction or major refurbishment;

(iv) to structure the sample by size band;

(v) to avoid excessive locational clustering of the sample; and

(vi) to emphasise those properties best known to the surveyors who were to take part in the survey.

It was hoped that the new dataset would include a significant sample of properties from the original sample in order that a simple longitudinal test of depreciation (a comparison of values at 1986 and 1996 for a constant sample of properties) might be made.

The final dataset comprised 128 office buildings. Of these, 82 were in the 1986 survey. If those 82, 26 had been rebuilt or had been the subject of major refurbishments with in the previous ten years and could not, therefore, be retained in the constant sample. This leaves 56 properties which were in the 1986 survey and the 1996 survey without obvious evidence of major expenditure in the interim period.

However, to claim too much for the quality of a longitudinal analysis would be misleading. No attempt has yet been made to trace the detailed history of these properties over the intervening period: any expenditure other than the cost of a major refurbishment would not be taken into account. This would mean that the assessed depreciation rate would not be accurate. More specifically, while it may provide interesting comparative data describing the value of properties on which no refurbishment expenditure has been applied, it would tend to under-estimate any decline in value over time because it is likely that some expenditure outside the tenant's normal responsibilities will have been made on some properties.

6.2 Selection of the dataset: West End

The collection exercise again began with the APR stock database, which in the West End comprised 398 buildings of over 10,000 sq ft. in Mayfair, St James's and Soho. This was reduced to 125 properties by a similar process as had been used in the City, emphasising a spread of size and age since construction or major refurbishment.

6.3 Data collection

Further data to be collected included (i) the scoring of building qualities for the sample properties and (ii) estimations of the yield and rental value for each property. This data was collected in two one-day sessions from a team of three surveyors for each market, including two letting agents and an investment surveyor.

Scoring was on a scale of 1 to 5, where 5 indicates highest quality. The qualities scored are the same as in 1986. These are:

(I) external appearance, including the impact of the entrance hall;

(ii) internal specification, including the quality of services;

(iii) configuration, including floor to ceiling height and plan layout; and

(iv) deterioration, both internal and external.

6.4 Data smoothing/preparation

6.4.1 Location

The surveyors interviewed thought that location (the area of the City within which the property was located, for example West and East, or postal area EC3 against EC2) would have a significant impact on rents. However, as in 1986, the analysis showed low correlation between wider location factors and rental value. Variations in site quality, on the other hand, were important: the street, the immediate neighbours and so on had an effect on rent with a correlation coefficient of 43 per cent. However, the correlation in 1986 had been *81 per cent*: this suggests a weakening of the importance of micro-location, probably with a corresponding increase in importance of building quality. This would suggest the possibility that depreciation rates will be higher in the new survey than in the 1986 research.

Given the inconclusive nature of the result, rental data was analysed twice, with the rents smoothed for the site effect, and on an unsmoothed basis. The smoothed results are reported for the purpose of comparison with the West End results and the 1986 analysis.

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The West End dataset showed a reasonably high (55 per cent) correlation between location, site quality and rental value. Location appears to be more important in the West End than in the City, a result which is confirmed by other RES research (RES, 1996). Rental data was smoothed by location score, and the reported results are based on the smoothed data .

6.4.2 Lot size

In 1986 the yield (capitalisation rate) data had been adjusted to account for lot size variations. High lot sizes sold on lower yields in 1986: the correlation was (minus) 59 per cent. In the 1996 survey, it was expected that there would again be a premium (yield discount) for large lot sizes, but this did not turn out to be the case. The correlation between lot size and yield was positive, and very small. Unlike 1986, therefore, no smoothing of the yield data was necessary for the City sample.

For the West End sample, high location scores were very positively correlated with large lot sizes, and both were associated with low yields. After location smoothing was carried out, no further relationship between lot size and yield remained, so that lot size smoothing was also unnecessary in the West End sample..

6.4.3 Refurbished and original buildings

The 1986 survey had distinguished between original and refurbished buildings. A statistical (chow) test suggested that the results for these sub-sets were not significantly different. The 1996 research produced the same result for the City sample; but in the West End the samples appeared to be statistically distinguishable from each other, so that what goes for the original building in the West End may not hold for the refurbishment..

The maximum age of an unrefurbished building was imposed as 35 years. This affected a small number of properties with reported ages greater than this since a major refurbishment, the veracity of which is highly doubtful.

6.5 Analysis

The average age of the 1986 office sample was 9.6 years; the 1996 equivalent was 14.9 years, a large increase. Given an expectation of no change in the long run, one must speculate about the fundamental difference in the study date in terms of the development cycle. The City office stock clearly appears to have aged in the 1986 to 1996 period.

The mean City rent fell from the 1986 sample mean of £32.33 to the 1996 sample mean of £22.66; yet inflation over the period would have taken £32.33 to £50.36. This inflation-adjusted rent ignores depreciation, sample ageing and changes in the real market value and can only at best be attributed to one, two or all of these factors: see below.

7. The 1996 Results: The City Market

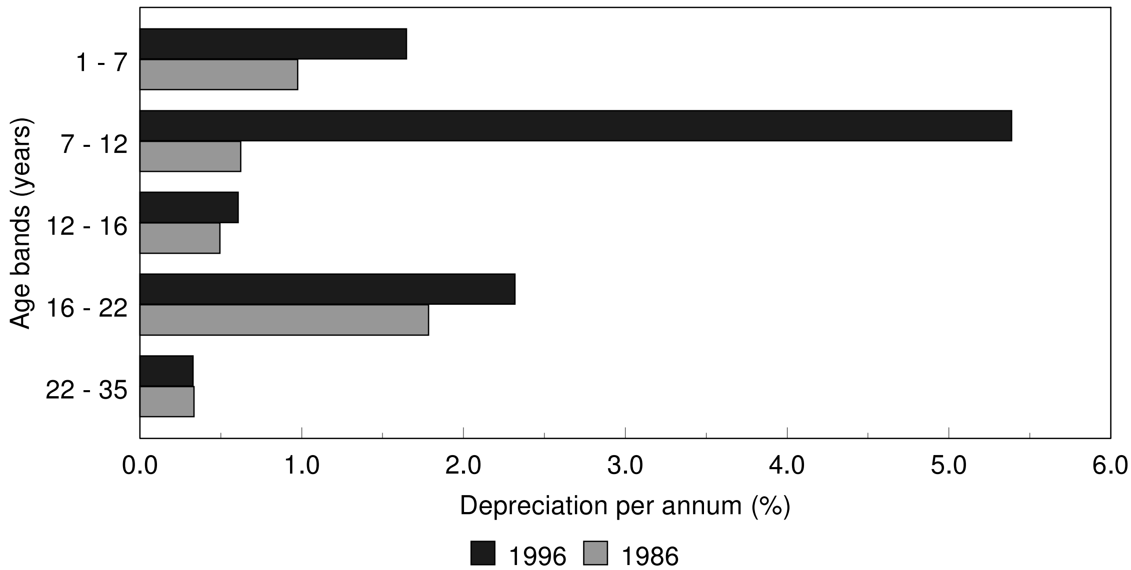
The main findings of the 1996 City office research were as follows.

7.1 Rental values

For all City office properties in the sample, rents fell from an average of £31.21 for properties with an average age of 1 year to an average of £15.18 for properties with an average age of 34 years. the annual rate of depreciation in rental value over (approximately) the first 35 years of life averaged 1.9 per cent. This was a large increase on the 1986 value of 1.1 per cent.

The period of greatest depreciation in rental values, previously years 17 to 26, was now much earlier (years 7 to 12) where the annual rate of depreciation reached *5.4* per cent. In brief, the incidence of depreciation in rent is now much more severe and affects the second review period by far the most.

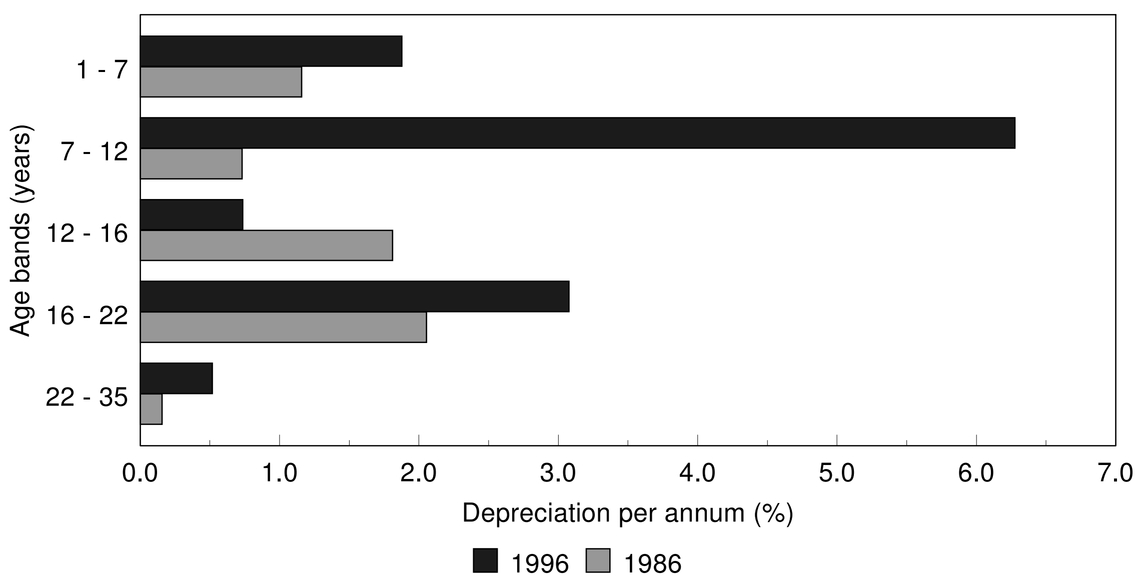
Figure 1: Depreciation in smoothed ERV and age band: City (1986 and 1996)



7.2 Capital values

The annual rate of depreciation in capital values averaged 2.9 per cent (1986: 1.6 per cent), half as much again than before. The period of greatest depreciation in capital values was again years 7 to 12 (1986: years 20 to 29), where the annual rate of depreciation reached 6.3 per cent, more than three times its maximum 1986 value.

Figure 2: Depreciation in smoothed CV and age band: City (1986 and 1996)



7.3 The impact of building quality

Building quality, again defined as a combination of obsolescence-related factors (configuration, internal specification and external appearance) and physical deterioration, was once more found to be a better explanation of rental value (and depreciation in rental value) than simple age. The difference in coefficients of determination was 68 per cent less 29 per cent; in 1986 this had been 73 against 39 per cent.

The results should be qualified by the fact that all building quality factors are positively correlated with each other, which damages the clarity of the rankings.

The most significant and important determinant of depreciation in rental value was found, by a clear distance, to be internal specification (1986: configuration), followed by physical deterioration (1986: internal specification) which, in 1986, had been least important. Least important in 1996 was external appearance. For explaining depreciation in capital value, the same results are clearly obtained.

Figure 3: Depreciation in smoothed ERV and qualities, City

	Parameter	T-ratio
Constant	4.15	
Exterior	0.49	0.70
Interior	2.90	4.03
Configuration	0.66	1.13
Deterioration	2.19	2.96
R squared	0.68	

The results indicate a major change in the demands of space users in the City. Configuration in 1986 was all-important, driven by the effect of Big Bang and the needs of financial services occupiers for clear areas of dealing space and underfloor space for cabling. In 1996 configuration of space had become less important, and the need is for high specification buildings, particularly in services, as traditional (non-dealing floor) uses of space appear to have more influence on market prices.

7.4 Curable and incurable depreciation

In this area the 1996 results were less significant than the 1986 results, because surveyors were less easily convinced that refurbishment expenditure would be worthwhile for a significant number of buildings. In all, only 18 properties of 128 were considered appropriate for refurbishment. Results significant at the 90 per cent confidence level only for rental values were an association between internal specification and incurable depreciation (unlike 1986, when configuration was more important) and between internal specification, external appearance and curable depreciation (in 1986, only internal specification was important).

Incurable and incurable depreciation were of roughly equal weight in 1986; in 1996, curable depreciation had become much the greater proportion. Two reasons for this may be suggested. First, buildings were by now probably more flexible than they had been in 1986. Second, the importance of configuration had declined relative to internal specification: the latter is curable, while the former is not.

8. The City Market: 1986-1996

Of the 128 properties in the 1996 survey, 82 were also in the 1986 dataset. Of these, Lambert Smith Hampton's records showed that 26 of these properties were the subject of serious refurbishment in the intervening period, leaving a dataset of 56 properties common to the 1986 and 1996 surveys.

The average age of these properties in 1996 was 17 years (7 in 1986, of course), with a standard deviation of 8.4 years, a maximum age of 45 years and a minimum of 10 years. The average size was 62,000 sq ft (maximum 305,000, minimum 10,000). The average (smoothed) rental value in 1996 was £18.96; in 1986, the same properties had an average (smoothed) rental value of £31.60. The correlation between the 1986 and 1996 rental values was 0.52: there was clearly a large range of subsequent performance.

It is possible to use this data to assess depreciation over time, both in rental value and capital value.

8.1 Rental value

The average rent for the July 1986 sample was £31.60; the average rent for the July 1996 sample was £18.96. This would suggest an average annual depreciation rate of *5.2 per cent*.

However, this incorporates the effect of movements in market value, including the demand for and supply of space. It is useful, therefore, to measure the differential movement in rents for the ageing 56 properties relative to the dynamic market.

The top rent in the 1986 sample is identical to the top rent (£40) in the 1996 sample. This may suggest that market values had not changed over the ten years, but this may be misleading, for two reasons.

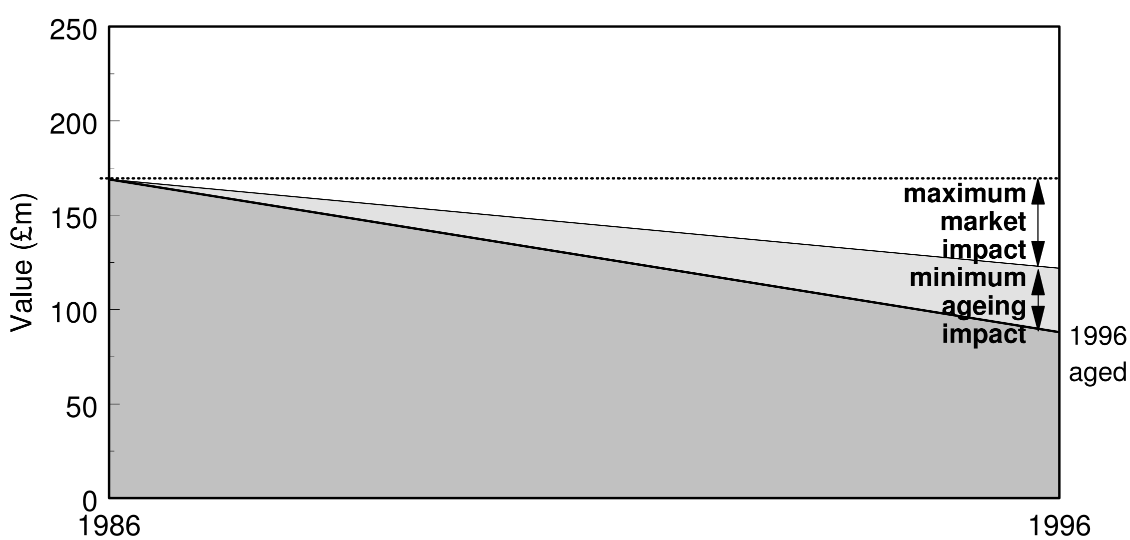
First, in 1996 incentives were still common as a means of maintaining 'headline' rents. Rent free periods of 12-18 months were not uncommon for new lettings, and the rents collected from surveyors in the 1996 survey were provided on a headline basis. This had not been the case in 1986. Hence the market had probably fallen in value, despite the maintenance of the headline rent.

Second, many would argue that in 1996 the market was less deep - in other words, that secondary properties were worth less as a proportion of prime values than would have been the case in 1986. So what was the average price movement in the City over the period?

IPD (IPD, 1997) measures year-end rental value and capital values for the City. In 1986, 361 properties had an ERV index of 169; this had fallen to 122 on 287 properties in 1996. The capital value index had fallen from 146 to 126 over the same period. Bearing in mind that the average age of this sample had almost certainly increased (see above), it should be borne in mind that the data will tend to exaggerate the like-for-like decline in market value and therefore tend to understate depreciation. The results are as follows.

The rental value depreciation rate for the sample is 5.3 per cent. Of this, a maximum of 3.3 per cent can perhaps be attributed to declines in market value; a minimum of 2 per cent remains as ageing-related depreciation.

Figure 4: Market and age impacts: value over time, City



This rate is similar to the average rate in the 1996 cross-section study (2.1 per cent). This is strong corroboration.

The cross-section and longitudinal results therefore show surprisingly high depreciation rates, but they are not incompatible with each other.

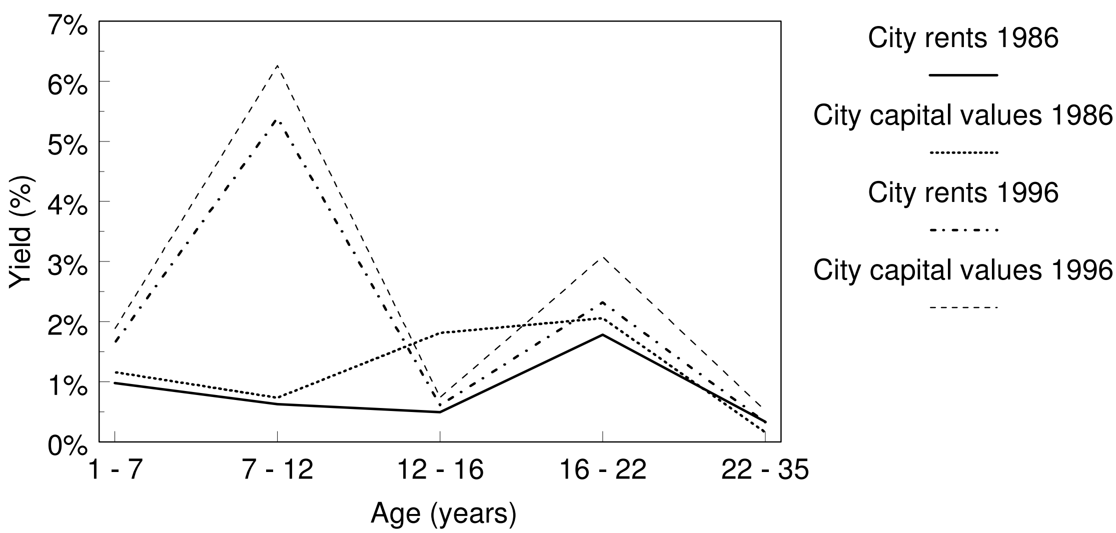
8.2 Capital value

The average (smoothed) capital value per square foot in 1996 was £278; in 1986, the same properties had an average (smoothed) capital value of £662 in 1986.

The capital value depreciation rate for the sample is 9.1 per cent. It is difficult, if not impossible, to attribute this to market value declines and the impact of age due to the impact of over-renting and the distorting effects of this upon yields.

In the 1996 cross-section study, the period of greatest depreciation in capital values was again years 7 to 12, where the annual rate of depreciation reached 6.3 per cent, somewhat supporting the longitudinal result. Capital values in the City office market appear to have depreciated in value by around six per cent for each year of age in the recent past.

Figure 5: Depreciation, 1986 and 1996, City



8.3 The impact of quality changes over time, 1986 to 1996

The variation in subsequent performance in terms of rental and capital values is clearly not explained by age, as all properties are ten years older but the correlation between rental and capital values for the two dates is as low as 50 per cent. This could be measurement error. More likely, the variation must be explained by variations in building quality, bearing in mind the smoothing of the locational effect.

This would be more likely if the correlation of 1986 building qualities with the 1996 scores were less than one. In all four cases, the correlation is between 0.4 and 0.5, with internal specification the least variable.

Changes in the average quality scores are instructive. Site scores were stable, averaging 3.6 and 3.7 in the two surveys. Configuration was, as expected, also stable at 2.9/2.8. Deterioration only fell from 3.4 to 3.2, suggesting continuing maintenance efforts by owners and perhaps occupiers, while internal specification (partly an obsolescence factor, and thereby incurable) fell from 3.2 to 2.7. The decline in external appearance quality (an obsolescence factor which is at least partly incurable) was greatest, from 3.5 to 2.2.

Figure 6: Average quality scores, 1986-1996, City

	External appearance	Internal specification	Configuration	Deterioration
1986	3.5	3.2	2.9	3.4
1996	2.8	2.7	2.8	3.2

However, changes in the external appearance score do not explain declines in rental value. The relationship is random, suggesting the taste of surveyors is not reflected in the rents occupiers are prepared to pay.

The suggested relationship is as follows:

change in rental value =
constant +
change in external appearance +
change in internal specification +
change in configuration +
change in deterioration

The relationship is not powerful: only 26 per cent of rent change is explained by these variables. Changes in location quality is likely to be the significant missing variable.

Within the measured factors, declines in rental value are instead explained by changes in the internal specification score, confirming the importance of this factor, and by changes in the deterioration score, again following the cross-section result. Internal specification is significant at the 95 per cent level; deterioration is significant at the 90 per cent level. Changes in configuration are insignificant. This may appear to be obvious, as the plan layout and floor to ceiling height will not normally change, but this finding may be interpreted as suggesting no major perceived changes in market notions of high configuration quality, and therefore a reassuringly low change in this sample.

For capital values, deterioration is the most significant factor explaining falls in value over the ten year period. Changes in the quality of external appearance and internal specification are also significant at the 90 per cent level.

8.4 Two case studies

The extremes of performance are illustrated by the following two properties.

21 Great Winchester Street, a building of 18,000 square feet which in 1986 was 16 years since a major refurbishment, was valued at that time at £386 per square foot. The ERV was £24; the yield on a new letting was estimated at 6.5 per cent.

In 1996, 26 years since refurbishment, it was valued at £19.50, 7 per cent and £278 per square foot. This was a decline in capital value of £107 or 28 per cent. 72 per cent of its underlying 1986 value remained, and it had declined in value at the same rate as the market (3 per cent). Ageing had not therefore affected the underlying value of the building. Its external appearance, internal specification, configuration and deterioration scores had all remained constant or improved by one point.

Token House, at 8-10 Telegraph Street, a major refurbishment of 17,000 square feet in 1985, was valued at that time at £673 per square foot, with an ERV of £32 and a yield of 4.75 per cent. In terms of underlying value (in other words, ignoring the impact of lease contracts), it was worth roughly double the value of 21 Great Winchester Street per unit of space.

In 1996, 11 years old and just past its second review, it was worth £133 per square foot, at £10 and 7.5 per cent. *It was now worth less than half the value of the comparison*. Its internal specification and deterioration scores had fallen by two points each and the external appearance had drifted by one point. It had fallen in value by £540 per square foot, or no less than 80 per cent of its underlying 1986 value: 20 per cent of that value remained. It had suffered depreciation of 18 per cent each year, of which perhaps 3 or 4 per cent can be blamed on the market.

9. The 1996 Results: The West End Market

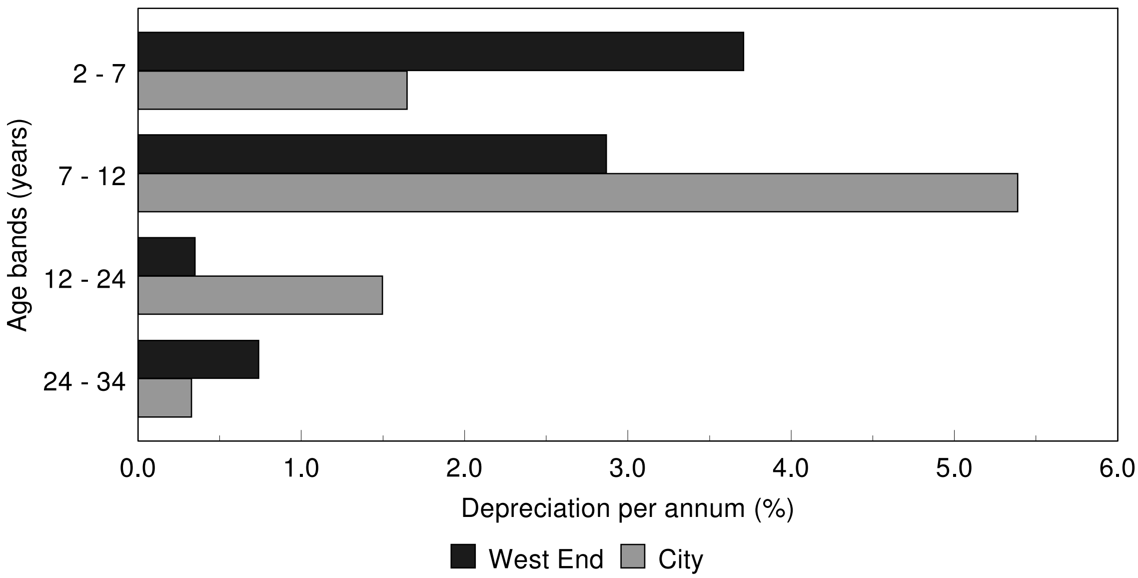
The main findings of the 1996 and first West End office depreciation study were as follows.

9.1 Rental values

For all West End office properties in the sample, the annual rate of depreciation in rental value over (approximately) the first 35 years of life averaged 1.6 per cent. This compares with a City value of 2.2 per cent.

The period of greatest depreciation in rental values was roughly the first rent review period, years 2 to 7 (City: years 7 to 11) where the annual rate of depreciation reached 3.7 per cent. The incidence of rental depreciation continued more evenly through the second review before becoming negligible from some time into the third review period. This is unlike the City result, where depreciation continued strongly through the first 25 years of life.

Figure 7: Depreciation in smoothed ERV and age band, West End



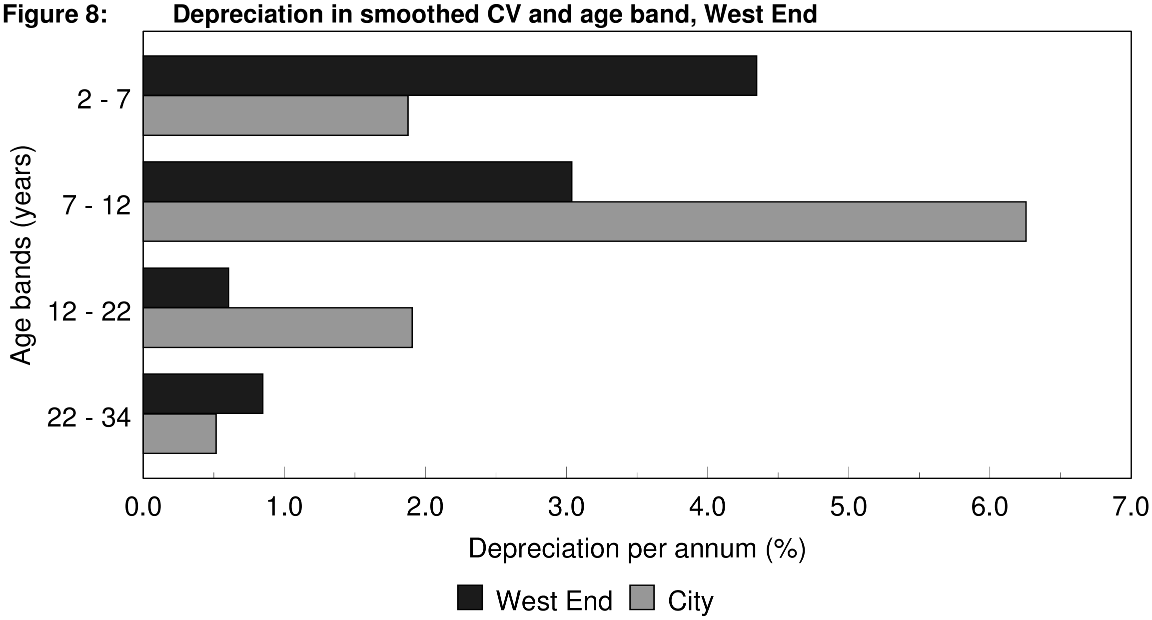
Note: City comparators are approximate

As office buildings age, rental value become dominated by ground rent; sites do not deteriorate, so the depreciation rate has to slow down. This point is expanded upon below.

9.2 Capital values

The annual rate of depreciation in capital values in the West End averaged 2.2 per cent (City: 2.8 per cent). The period of greatest depreciation in capital values was again the second and third review periods.

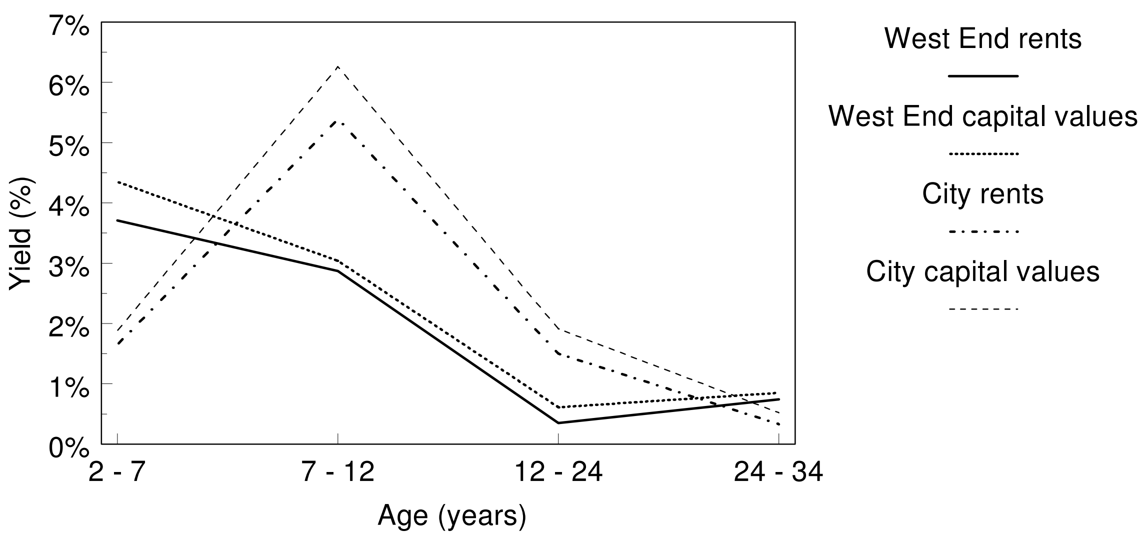
Figure 8: Depreciation in smoothed CV and age band, West End



Note: City comparators are approximate

If rental and capital values decline by around or just over a half of one per cent more in the City than the West End, this factor per se would justify average capitalisation rates of half a point more in the City than in the West End.

Figure 9: Depreciation, West End and City, 1996



9.3 The impact of building quality

The West End data produced a curious anomaly. While building quality factors are positively correlated with each other for City and West End samples, the one exception is the relationship between external appearance and configuration in the West End, which are negatively correlated. An obvious reason for this is the dominance of popular classical exteriors, associated with unpopular floor layouts and ceiling heights, in the West End market. The result is that external appearance has no explanatory power with regard to rental or capital value in the West End office market: but the results differ between original and refurbished offices (see below).

Building quality was found to be a better explanation of rental value (and depreciation in rental value) than simple age, although the difference was less marked than in the City and the significance of the results was generally weaker. The difference in coefficients of determination was 55 per cent (City: 68 per cent) against 38 per cent.

Figure 10: Total depreciation in smoothed ERV: all buildings (West End)

	Parameter	T-ratio
Constant	4.72	
Exterior	0.25	0.35
Interior	1.63	1.74
Configuration	1.27	1.57
Deterioration	3.78	3.64
R squared	0.55	

The most significant and important determinant of depreciation in rental value was found, by a clear distance, to be deterioration (City: internal specification, followed by deterioration). Least important (and insignificant) was external appearance. For explaining depreciation in capital value, the same results were obtained, with internal specification of second greatest importance.

9.4 Original and refurbished buildings

Depreciation runs at a slightly lower rate for original buildings in the West End than it does for refurbishments. Rents decline at 1.5 per cent for the former, against 1.9 per cent for the latter. Capital values decline at rates of 1.9 and 2.2 per cent respectively for originals and refurbishments.

Depreciation also runs at a steadier rate for original buildings in the West End than it does for refurbishments. The rental depreciation rate declines steadily from 2.45 per cent over the first review to 0.55 per cent beyond the first 25 year lease; for refurbished properties the first review rate is as high as 4.2 per cent, the second review period is at 2.9, the rate of decline over years review periods 3 and 4 is nil, and the period from age 20 to 35 sees depreciation pick up to 1.25 per cent. The result is repeated for capital values.

This is consistent with an argument which suggests that the depreciation rate is related to the life of the building, which is higher for refurbishments (classical buildings) with the effect that depreciation continues for longer.

External appearance and rent are negatively correlated for original properties, and positively correlated for refurbishments. This throws some light on the result reported earlier. It suggests that original properties in the West End (average age: 25 years) are less attractive externally than classical office properties, but are more useful and therefore more valuable.

Physical deterioration is the most important factor for both samples.

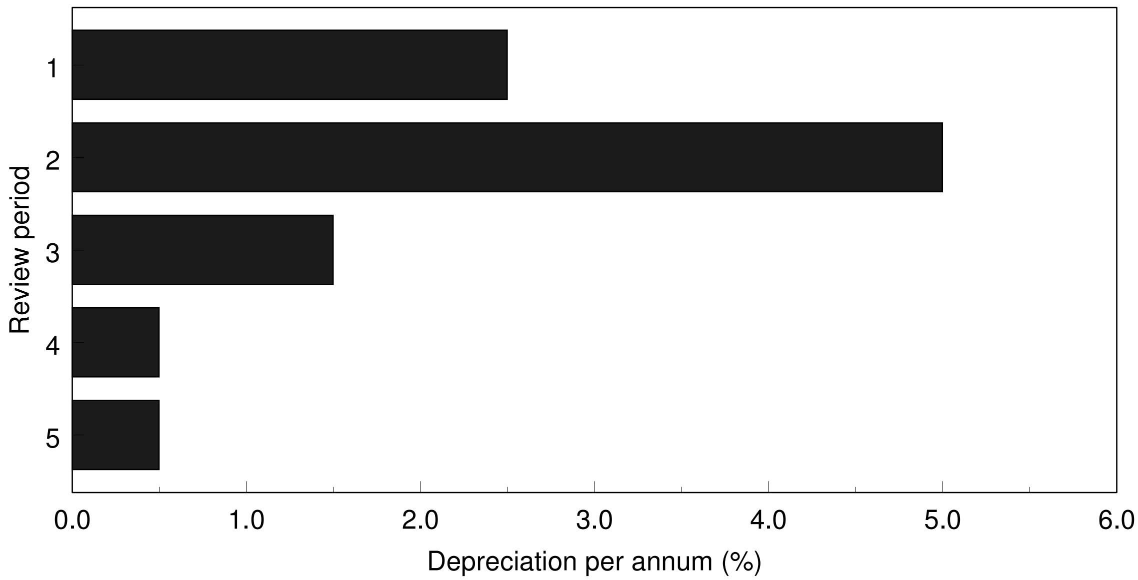
9.5 Curable and incurable depreciation

In the City, only 18 properties of 128 were considered appropriate for refurbishment. In the West End the number was 40. As in the City, and with even greater strength, curable depreciation was the greater proportion.

10. The 1996 Results: Rental Depreciation, Central London

For all 253 central London offices analysed, the average rate of depreciation in rents is 1.6 per cent; the rate approaches 2.5 per cent over the first review, climbs to over 5 per cent for the second review, falls to 1.5 per cent for the third review and to less than 0.5 per cent for the fourth and fifth review. Thereafter, the rate of decline is nil - arguably, as the decapitalised site value is attained.

Figure 11: Depreciation in smoothed ERV and age band, central London



11. The 1996 Results: Other Findings

11.1 Building lives

Capital values in the City office market appear to have depreciated in value by around 2.9 per cent for each year of age. Assuming site values of 50 per cent of prime value, the maximum life of a building would be around *25 years*. This is a surprising result. If building lives are considered to be longer - our survey suggested 40 years - site values would have to be as low as one-third of the total property value. At depreciation rates of 1.6 per cent each year, 40-45 years was the implied building life assuming 50 per cent site values in the 1986 research. Building lives in the City are shorter than they were.

In the West End, the implied life is longer, at 35 years.

11.2 Depreciation is not forever

Depreciation for older property is lower than depreciation on new property. This is because properties are closer to the end of their building lives and therefore close to their site values. When depreciation rates are calculated into perpetuity depreciation rates for older property are therefore lower than for equivalent new buildings.

In all 1996 results, depreciation rates tend towards zero as the building age approaches (say) 30 years.

11.3 City and West End

The yield gap between the City and West End varies from less than a quarter point (lower in the West End) for newer properties to a full percentage point for older properties.

If rental and capital values decline by around or just over a half of one per cent more in the City than the West End, this factor per se would justify average capitalisation rates of half a point more in the City than in the West End. Reported yields for our two samples suggest that yields in the West End are lower across all ages, but only by an average of 0.25 per cent. The City may be over-priced relative to the West End.

11.4 Age and pricing

It is possible to make some generalised comment on the relationship between observed prices and hypothesised 'correct' prices. To do so we need to use a model for correct pricing (see section 2 above) and make some assumptions.

The simple perpetuity model is as follows: .

$$RFR + r = k + g - d$$

So that: $$k = RFR + r - g + d$$

If we can estimate the long term values of r, g and d and the risk free rate, adjusted marginally by the cash flow pattern of property and the inflation effect, we can then produce an estimate of the correct value of k.

Assuming a risk free rate derived from long gilts at 8 per cent, a risk premium for property over gilts of 3 per cent, long term inflation expectations at 4 per cent and no real expected rental growth, the correct yield on a prime City office building with average rental depreciation running at 2.2 per cent would be: *9.2 per cent.* The current average yield based on our sample, of new City properties is 6.3 per cent.

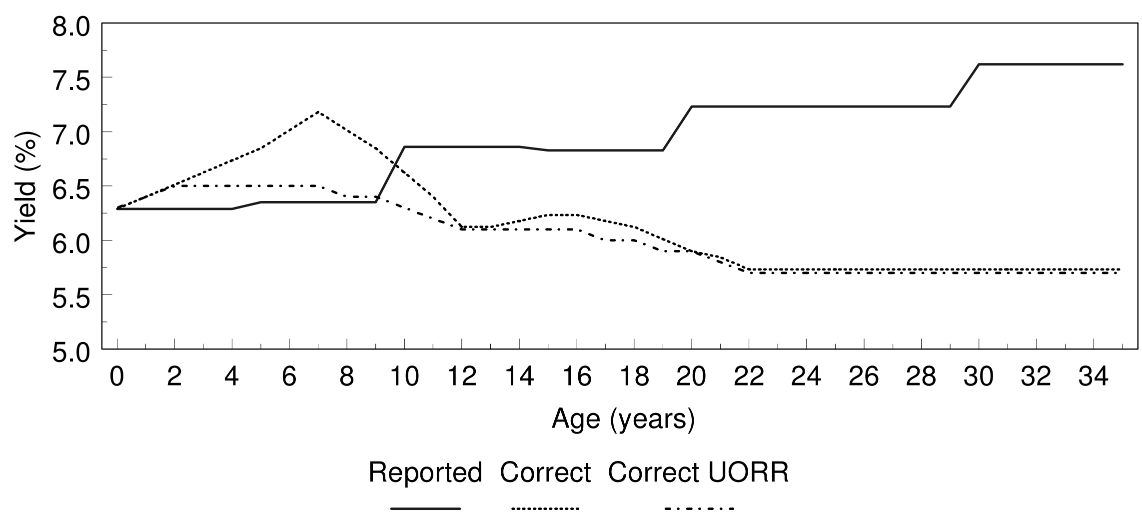
This does not necessarily suggest over-pricing: we have made many simplifying assumptions,. More interesting is a comparison of 'correct' yields and reported yields for different age bands. This does suggest an anomaly.

Reported yields rise as age increases, from 6.3 for new properties to 7.6 for older properties. These are let at the current rental value on new 15 year leases with upward only rent reviews.

Correct yields, calculated on the same basis but with annual upward and downward rent reviews, do not rise with age. Instead, there is an initial rise followed by a fall. The data suggests the greatest pricing error at year 7, just before the period of high depreciation rates is suffered; and the best value at year 34, where the error is at its minimum.

This illustrates one or both of two conclusions: first, City investors are highly dependent on long leases with upward rent reviews to protect the value of depreciating assets; second, they appear to be over-paying for new investments, as better value is available in the older sector of the City market. In order for this conclusion to be incorrect, newer buildings have to demonstrate much higher average rental growth and/or investors have to be prepared to accept lower returns on new buildings.

Figure 12: Reported and correct yields, City



12. Conclusions

The attraction of property compared to other assets is undermined by the effects of depreciation reducing value over time. It is essential that adequate provision for the effects of depreciation is made in any property investment analysis.

In 1986, rental values for City offices had been found to be been declining at just over 1 per cent per annum. Capital values had been falling at 1.6 per cent, as buildings aged. However, building qualities, not ages, were found to be better at explaining falls in value

Configuration of space had been the most important building quality in 1986, about the time of Big Bang and explained incurable depreciation, while internal specification explained curable depreciation.

Since 1986, the City office stock has clearly aged and average rents have fallen. In the last ten years, City office market rental values have fallen by 1.5 per cent per annum: but ageing has led to further declines for our sample of properties of nearly 4 per cent. Rental value depreciation has increased from 1.1 to 2.2 per cent. with the impact concentrated over the second review period. Capital value depreciation has increased from 1.6 to 2.9 per cent with the impact on the second review period three times as great as it had been in 1986.

Internal specification is now more important than configuration and maintenance of the fabric has become more important; curable depreciation is now more important than incurable effects, because buildings are more flexible.

Rental value depreciation in the West End is lower than in the City and disappears after the second review. Capital values decline by nearly 2 per cent, less than in the City. West End yields should be at least half a point lower than City yields.

Good looking buildings in the West End have low rents because configuration and deterioration are more important in explaining rental depreciation. Refurbishments depreciate slightly more quickly but depreciation of refurbishments tails off to zero after the second review.

Building lives are getting shorter. But depreciation is not forever: depreciation for older property is lower than depreciation on new property. Better underlying value is available in older buildings.

Depreciation is now much more important as a driver of property investment performance. Even the central London office market, arguably the best-researched sector of one of the world's most efficient property markets, offers the potential for serious damage - and also for serious profits, generated through wise investment in a mispriced market.

Acknowledgements

We would like to thank Mark Charlton of Lambert Smith Hampton, Paul Richards, formerly of Lambert Smith Hampton, and colleagues at HRES for their technical input; we would also like to thank the surveyors at Lambert Smith Hampton who contributed time, effort and data to this research.

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