# Sector and Regional Factors in Real Estate Returns

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**Abstract**

This paper presents a simple method to measure the effect of sector and regional factors in real estate returns, and thus provides a quantitative framework for analysing the relative impact of these two diversification categories to real estate portfolio selection. Using data on Retail, Office and Industrial properties spread across 326 real estate locations in the UK, over the period 1981 to 1995, the results show that the performance of real estate is largely sector-driven. A result in line with previous work. Which implies that the sector composition of the real estate fund should be the first level of analysis in constructing and managing the real estate portfolio. As a consequence real estate fund managers need to pay more attention to the sector allocation of their portfolios than the regional spread.

# Sector and Regional Factors in Real Estate Returns

## Introduction

The use of Modern Portfolio Theory (MPT) for investment implies a top-down approach to portfolio allocation. The first decision to be made is to decide how much to allocate to each broad asset category; and second, the optimal allocation within each asset category. The first level decision has received considerable attention over the last few years with the place of real estate within mixed-asset portfolio being heavily scrutinised (see for example Byrne and Lee, 1995). The second level decision, that of the optimal composition within the property portfolio, as now begun to receive more attention (see McNamara and Morrell, 1994).

For real estate portfolios, the conventional approach to defining diversification categories is to use sector and regional classifications. This kind of classification recognises that different factors are likely to influencing the performance of property at both the sector and regional level. This sector and geographical diversification portfolio selection strategy supported by surveys of institutional investors' diversification approaches (Webb, 1984; Louargand, 1992 and De Witt, 1996).

In following a sector/regional diversification strategy real estate fund managers could employ two approaches to portfolio selection. That is in deciding to allocate funds by first sector followed by region or first by region and then sector. This first strategy is based on the belief that sector factors are the predominate driver of property returns. While the second approach would be followed by a fund manager who believes that real estate returns are more influenced by regional factors. The question that needs to be asked therefore are sector or regional factors more important in determining real estate returns?

This paper presents a simple method to measure the relative importance of these sector and regional factors in real estate returns, and thus provides a quantitative framework for analysing impact of the two approaches to real estate portfolio selection. In particular the results show that sectors factors dominate regional factor effects, indicating that real estate returns are sector-driven. This implies that the sector composition of the real estate fund should be the first level of analysis in constructing and managing the real estate portfolio. As a consequence real estate fund managers need to pay more attention to the sector rather than the regional composition of their portfolios.

The paper is set out as follows. The first section presents the data on which the analysis is based: total returns from the Investment Property Databank (IPD) *Key Centres Report*. Following which the next section describes the method of analysis. While the third and fourth sections presents the results and discuss the implication for the development and management of a real estate portfolio selection strategy. The final section presenting the conclusions of the study.

**Data**

The sample data consists of the total returns on properties in three sectors, Retail, Office and Industrial in a total of 326 locations (essentially towns) in the UK over the period 1981 to 1995. The data are derived, with additions, from the *Key Centres Report* (IPD, 1996a). The data in the *Key Centres Report* are drawn from a total database of 12,302 properties at the end of 1995 with a aggregate value of £47,867m. To protect confidentiality no data are published for areas containing fewer than four properties in any of the years. For Offices and Industrials the *Key Centres* results are based on all Offices and Industrial properties covered by IPD in each location. For Retails, however, given the breakdown in the divisions between the real estate sectors with the advent of Retail warehouses, Retail related distribution warehouses and the like, in order to provide a Retail sample on a like for like basis only standard shops, that is standard ‘high street’ Retail stores, in each location are covered. The *Key Centres* data are also classified into the Standard Regions of the UK (see Figure 1) but with the South East subdivided into London and the Rest of the South East, as London represents a dominant area of institutional property investment (IPD, 1996b). Table 1 summarises the property sector and regional breakdown of the data.

**Figure 1: The UK Standard Regions**

As can be readily appreciated from Table 1 the data are unevenly spread across both the sectors and regions. With just over 54% of the sampled properties in the Retail sector and with 52% of the property data concentrated in just two regions, London and the South East. Reflecting the institutional bias to the South of England (IPD, 1996b).

**Table 1: The Number of Data Points in Each Sector/Region**

| | Sectors | | | |
|---|---|---|---|---|
| **Regions** | **Retail** | **Office** | **Industrial** | **Overall** |
| London | 28 | 26 | 17 | 71 |
| The South East | 51 | 20 | 31 | 102 |
| South West | 19 | 6 | 7 | 32 |
| East Anglia | 8 | 4 | 5 | 17 |
| East Midlands | 8 | 2 | 3 | 13 |
| West Midlands | 13 | 2 | 4 | 19 |
| Yorks. and Humberside | 14 | 4 | 3 | 21 |
| The North West | 16 | 5 | 2 | 23 |
| The North | 7 | 1 | 0 | 8 |
| Scotland | 9 | 3 | 3 | 15 |
| Wales | 3 | 1 | 1 | 5 |
| **Overall** | 176 | 74 | 76 | 326 |

*Descriptive Statistics*

Table 2 shows the descriptive statistics for the sector and regional data over the period 1981 to 1996, based on equal-weighted sector and regional portfolios. As can be see in Table 2 the best performing sector was Industrial property (12.62%) while the Office sector performed the worst (9.40%). The best performing region was the East Midlands (13.31%) and the worst Scotland (10.56%). However, high returns were not necessarily associated with higher levels of risk (standard deviation). The lowest level of risk in the sectors was in Retail which offered the second best returns. While the region with the highest risk (London) showed the second worst returns. In the UK Offices, especially in London, performing the worst over this period.

**Table 2: Descriptive Statistics**

| Sector/Region | Mean (%) | SD (%) | Average Correlation |
|---|---|---|---|
| **Sectors** | | | |
| Retail | 11.21 | 8.76 | 0.79 |
| Office | 9.40 | 11.20 | 0.84 |
| Industrial | 12.62 | 11.81 | 0.78 |
| **Standard Regions** | | | |
| London | 10.64 | 11.38 | 0.83 |
| South East | 10.88 | 9.78 | 0.86 |
| South West | 11.83 | 8.75 | 0.87 |
| East Anglia | 11.19 | 9.48 | 0.86 |
| East Midlands | 13.31 | 10.12 | 0.86 |
| West Midlands | 11.05 | 8.44 | 0.86 |
| Yorks. and Humberside | 11.80 | 8.43 | 0.87 |
| The North West | 11.49 | 7.75 | 0.85 |
| The North | 10.73 | 7.08 | 0.76 |
| Scotland | 10.56 | 6.11 | 0.80 |
| Wales | 10.91 | 7.74 | 0.76 |

The correlation coefficient plays a major role in determining the place of an asset in a portfolio in MPT. As it is through the less than perfect positive correlation between assets that diversification is achieved. Since the sector and regional data incorporate the same properties, the average correlation coefficients can be used to compare the potential benefits of diversification across regions in the same sector with sector diversification within a region. The average correlation values presented in Table 2 shows that the amount of risk reduction that can potentially be achieved within the UK real estate market is likely to be small, due to the high average correlation's between the assets. However, whether sector or regional factors are relatively more important in explaining real estate returns can not be derived from inspection of average risk and return levels. The next section therefore presents a simple method to quantify the impact of sector and regional factors to real estate portfolio selection.

**Method**

In order to separate the sector factor effects from regional factor effects, we apply the approach of Heston and Rouwenhorst (1994) and Beckers, Connor and Curds (1996) and postulate the following model for the return on the *ith* property that belongs to region *j* and sector *k* :

$$R_i = \alpha + \sum_{j=1}^{M} \beta_{i,j} F_j + \sum_{k=1}^{L} \lambda_{i,k} F_k + \varepsilon_i \qquad (1)$$

where:

| | | |
|---|---|---|
| $R_i$ | = the return of property i in time period t | i = 1,....N |
| $\alpha$ | = the return on the market in general | |
| $\beta_j$ | = the return to the regional factor j | j = 1,.....M |
| $\lambda_k$ | = the return to the sector factor k | k = 1,....L |
| $F_j$ | = 1 if the property is in region j, 0 otherwise. | |
| $F_k$ | = 1 if the property is in sector k, 0 otherwise | |
| $\varepsilon_i$ | = a random error term | |

The formulation used in Equation (1) is a very simple factor model of returns with zero/one exposures to the explanatory variables (sectors and regions) which elegantly allows for the separation of the regional and sector effects, but rules out any interaction between these effects. That is a property's return is broken down into two components: a sector factor return and a regional factor return. It is also assumed that the property-specific disturbances have a zero mean and finite variance for returns in all sectors and regions, and are uncorrelated across properties..

However, it is not possible to estimate Equation (1) directly by cross-sectional regression techniques, because it is undefined, due to the perfect multicollinearity between the regressors. Since the regional and sector dummies add up to a unit vector across properties, as every property location is in one sector and one region. As a result there is no unique way of identifying sector and regional effects, we can only measure cross-sectional differences between regions and cross-sectional differences between sectors.

The usual identifying restriction employed in this case is to force one of the $\beta_j$ and one of the $\lambda_k$ to be zero. Mechanically one would arbitrarily choose one region in one sector as a base, and estimate Equation (1) under the restriction that this sector/region is zero. This however makes the estimated coefficients very difficult to interpret. For example, if we were to force the Industrial sector factor to zero as well as the Scottish regional factor, each of the coefficients of the dummy variables in Equation 1 would now indicate the sector and regional effects on real estate returns net of Industrial properties located in Scotland, which probably means very little to the casual observer.

Suits (1984) and Kennedy (1986) both suggest, however, that once the restricted version of Equation (1) is estimated the coefficients of the eliminated region and sector can be recovered by adding any constant *h* to each $\beta_j$ and any constant *c* to the $\lambda_k$, while (*h*+*c*) is subtracted from the intercept $\alpha$ . Since the addition and subtraction of a constant leaves the values of $\varepsilon_i$ unaffected. Where *h* is determined as -($\sum P_j\beta_j$) and *c* by $-(\sum P_k\lambda_k)$. Where $P_j$ and $P_k$ are the proportions of the data in each region j and sector k respectively. Notice that if the identifying restrictions $\sum \beta_j F_j = 0$ and $\sum \lambda_k F_k = 0$ were imposed, then the ordinary least squares estimate of Equation (1) would produce $\hat{\alpha} = \frac{1}{N}\sum_{i=1}^{N} R_i$ as the estimate of the intercept $\alpha$. That is once the coefficients of the dummy variables are ignored the intercept value $\alpha$ is the average performance of an equal-weighted portfolio of the sampled properties. Which not only makes the interpretation of Equation 1 easier to understand, as adding the two equality restrictions implies that the sector and regional factor returns are now measured net of the equal-weighted market return, but as the advantage of using all the sector and regional data.

So for example, if property returns market-wide are mostly positive in general in a given year and Office properties are also rising but less so than the market, then the Office factor return will be negative. The same holds for the regional factors. If property returns are generally positive and Scottish properties are also rising but by less than in most other regions, then the Scottish regional factor return will be negative. The amount of an property's return arising from each factor component dependent on its exposure to that source.

Thus the estimated coefficients of the dummy variables using Equation 1 for each of the sector factors, $\lambda_k$ can be interpreted as the return net of the equal-weighted property portfolio that is invested only in sector k and has no position in other sectors. This sector portfolio is regionally diversified, in the sense that it has the same regional composition as the equal-weighted property wide portfolio, and is therefore a pure sector investment. In a similar way the estimated coefficient of $\beta_j$ is the return of region j above the equal-weighted property portfolio of a diversified portfolio of sectors within the region and so represents a pure regional investment. The estimated magnitude of the coefficients of $\lambda_k$ and $\beta_j$, therefore, indicate the performance of the sectors and regions in each year above and beyond that of the property market and so the relative importance of the sectors/regions in determining the performance of the property portfolio in general.

The estimation procedure also allows a decomposition of the actual return of an equally weighted sector or regional portfolio into a number of components of interest. For example, the actual return of a sector portfolio $R_k$ can be broken down into a factor a common to all sectors, $\alpha$, sector-specific component $\lambda_k$, and the average of the regional effects of the properties that make up the sector,

$$R_k = \hat{\alpha} + \frac{1}{M_k}\sum_{i}\sum_{j=1}^{11}\hat{\beta}_j F_{ij} + \hat{\lambda}_k \qquad (2)$$

where the i-summation is taken over the properties in sector k. Equation (2) states that the return in the Office sector, for example, may differ from that of a UK wide equally weighted market portfolio for two reasons. First, because the regional composition of the Office market is different from the regional composition of the market as a whole. Second, the return on Office properties is different from that of real estate which are in the same region but located in a different sector.

In a similar way the actual return of a regional property portfolio $R_j$ can be decomposed into a factor common to all regions, $\alpha$, the weighted average of several sector factors and a regional-specific factor, $\beta_j$,

$$R_j = \hat{\alpha} + \hat{\beta}_j + \frac{1}{L_j}\sum_i \sum_{k=1}^{3} \hat{\lambda}_k F_{ik} \qquad (3)$$

where the i-summation is taken over the properties in region j.

The excess returns can then be found by subtracting $\hat{\alpha}$ from each sector and regional return and then decomposing the variance of the excess returns into a pure sector (regional) component and a weighted average regional (sector) component.

Note that the regressions above produce the net return effects of the sector and regional factors for one particular year. By running the cross-sectional regressions for each year a *time-series* of geographically-diversified sector portfolio returns, $\hat{\alpha}_t + \hat{\lambda}_{kt}$, and sector-diversified regional portfolios, $\hat{\alpha}_t + \hat{\beta}_{jt}$, are obtained. These returns can then be used to analyse the sources of variation in sector and regional portfolio returns.

**Relative Importance of Sector/Regional Effects**

The decomposition of the excess sector and regional portfolio returns are shown in Table 3. For example, the first row shows that over the period 1981 to 1995 an equal-weighted Retail sector portfolio, with the same regional composition as the equal-weighted UK property portfolio, achieved a return on average of 0.03% per annum above that of the market in general, with a variance of 12.25% squared per year. The South East region meanwhile under-performed the equal-weighted property portfolio by -0.41% per annum on average, with a variance of 1.65% squared per year.

The top panel of Table 3 shows that the majority of the variance of the excess equally weighted sector returns can be attributed to sector-specific effects. The variance of the combined regional effects accounting for an average of only 1% of the variation in excess sector returns, due in part to the diversification of the sectors across the regions. However, the more important reason becomes clearer from inspection of decomposition of the regional effects in the lower panel in Table 6. Since although most of the variation in excess regional returns is due to regional effects, with the average sector effects accounting for only 16.6%, the average variance of the pure regional effects is only 8.83% squared, compared with the average variance of the pure sector effect at 18.35% squared.

The most notable feature in Table 3 then is that the average absolute value of the sector coefficients (1.09%) is more than twice that of the regional coefficients (0.54%), while the average sector variance (18.35% squared) is more than double the variance of the regions (8.83% squared). Also, except for investment in the peripheral regions (The North, Scotland and Wales) the variances of each sector effect is greater than for each regional effect. Consequently, sector effects account for most of the variation in property returns.

**Table 3: The Decomposition of Excess Returns into Sector and Regional Factor Effects**

| Sector | Mean | Pure Sector Effect: Variance | Pure Sector Effect: Ratio to market | Sum of Regional Effects: Variance | Sum of Regional Effects: Ratio to market |
|---|---|---|---|---|---|
| Retail | 0.03 | 12.25 | 1.039 | 0.13 | 0.010 |
| Office | -1.68 | 11.95 | 1.002 | 0.26 | 0.021 |
| Industrial | 1.57 | 30.85 | 1.056 | 0.15 | 0.005 |
| **Absolute Average** | 1.09 | 18.35 | 1.032 | 0.18 | 0.012 |

| Region | Mean | Sum of Sector Effects: Variance | Sum of Sector Effects: Ratio to market | Pure Regional Effect: Variance | Pure Regional Effect: Ratio to market |
|---|---|---|---|---|---|
| London | -0.26 | 0.96 | 0.117 | 8.20 | 0.913 |
| South East | -0.41 | 0.21 | 0.128 | 1.65 | 1.545 |
| South West | 0.65 | 0.15 | 0.129 | 1.14 | 0.779 |
| East Anglia | -0.02 | 0.35 | 0.277 | 1.28 | 0.670 |
| East Midlands | 2.06 | 0.26 | 0.094 | 2.73 | 1.157 |
| West Midlands | -0.26 | 0.99 | 0.168 | 5.90 | 1.460 |
| Yorks. and Humberside | 0.75 | 1.06 | 0.175 | 6.07 | 1.622 |
| The North West | 0.57 | 1.86 | 0.302 | 6.16 | 0.887 |
| The North | -0.22 | 7.33 | 0.422 | 17.37 | 0.754 |
| Scotland | -0.56 | 0.22 | 0.010 | 20.86 | 0.981 |
| Wales | -0.21 | 0.22 | 0.008 | 25.72 | 1.051 |
| **Absolute Average** | 0.54 | 1.24 | 0.166 | 8.83 | 1.074 |

Note: The variance ratios do not sum to one due to a small covariance between the sector and regional effects

A conclusions confirmed by the average adjusted $R^2$ values for the sector and regional effects from applying Equation (1) to the property data. As over the period from 1981 to 1995 on average the sector factors explained 22%, or more than one fifth, of the variability in real estate returns of the sampled property. While the regional factors accounted for a mere 8%. That is the sector factors are almost three times as important in explaining return variability of real estate than regional factors. Sector effects are consequently relatively more important than regional effects in determining property portfolio returns which as important implications for portfolio performance and risk reduction. The results may need to be viewed with caution, however, as they may reflect the larger size of the sector categories and/or the more even spread of the data across the sectors compared with the regional data. Therefore are the results above simply a reflection of regressing three “large” so called sector portfolios against the returns data, rather than a true sector component?

In order to test this proposition three random portfolios were constructed from the sample by dividing the data in three equal sized “pseudo” sector portfolios. In other words three portfolio were randomly constructed by sampling, without replacement, from the data set irrespectively as to whether the property was from the Office, Retail or Industrial sectors. These “pseudo sector” factor portfolios were then regressed against the total returns data in the same way as the “actual” sectors above for each year and the results averaged over the fifteen periods. The results of which show a dramatic difference in explanatory power between the “actual” and “pseudo” sector factor portfolios. In comparison with an average R-squared value for the “actual” sectors of 22%, the “pseudo” sector portfolios averaged less than 0.5% and no more than 1.5% in any one period. As a consequence we can feel confident that categorising property into the three property-types Retail, Office and Industrial does indeed provide a significant explanation of real estate returns.

## The Implications for Real Estate Fund Managers

### *Portfolio Performance*

Typically fund managers attempt to out-perform a benchmark of performance in two ways: (1) through *selection* (stock picking) and/or (2) *structure* tilting (that is holding different portfolio weights from those of the benchmark). In terms of structure bets a fund manager needs to know whether sector or regional variations from the benchmark portfolio achieve the greatest impact in performance. For example, suppose a UK real estate fund manager is considering a sector bet by increasing his weight into Industrials, or a regional bet as a result of a tilt towards London. Because the Industrial sector contributes 76 properties, while London contributes 71 properties to the sample (see Table 1) both tilts are almost equally diversified. The results from Table 3, however, indicate that replacing 10% of the properties in an equal-weighted

UK property portfolio with London would have resulted a slight under-performance of -0.03% per year, with a tracking error variance of only 0.82% squared per annum. In comparison a 10% tilt by the fund manager into Industrial properties, while maintaining the regional composition of the portfolio, would have led to an over-performance of the benchmark portfolio of 0.16% per annum, with a tracking error variance of 3.09% squared per year. A tracking error variance almost four times greater than that for the London regional tilt. Therefore, as the tracking errors induced by tilting a portfolio away from the sector composition of the benchmark portfolio are greater than for regional tilts, real estate fund managers need to pay more attention to the sector rather than the regional composition of their portfolios.

*Sector and Regional Diversification*

The relative size of the sector and regional effects has important implications for risk reduction in a portfolio. For example when selecting properties, a real estate fund manager achieves risk reduction through the benefits of both sector and regional diversification. Therefore, when a fund manager wishes to reduce portfolio risk he needs to know whether a greater reduction in risk can be achieved by focusing on regions within a sector, or sectors within a region, or both. The results in Table 2 indicate that it is more important to diversify within a region across different sectors than to diversify within a sector across regions to obtain the largest reduction in portfolio risk. As shown by the fact that the variance of the sector factor effects is larger than the regional effects. This indicates that the average correlation of properties in different regions across a sector must be higher than the average correlation of properties in different sectors in the same region. In other words two properties in the same sector are closer substitutes than two properties in the same region. As a consequence compared with the average variance of an individual property, the reduction in risk of a naively diversified portfolio will be greater within a region across sectors than by sectors across regions. The amount of risk reduction obtainable given by the analytical expression of the relationship between the number of property holdings and volatility first expressed by Markowitz (1959) as follows:

$$\sigma_p^2 = \frac{1}{n}\bar{\sigma}^2 + \frac{n-1}{n}\bar{\sigma}_{i,j}$$

where:

$\sigma_p^2$ = portfolio variance

$\bar{\sigma}^2$ = average variance of all assets

$\bar{\sigma}_{i,j}$ = average covariance between all assets

n = the number of assets

Therefore as n increases the first term on the RHS of the Equation tends to zero and the risk of the equal-weighted portfolio tends to the average covariance between the assets. However, the average covariance of a large group of properties is just the variance of an equal-weighted portfolio. The percentage reduction in portfolio risk from diversifying across sector and/or regions is simply one minus the ratio of the variance of the equal-weighted sector and regional portfolios to the average variance of the individual data.

For example, the average variance of an individual property across the whole sample is 144.1% squared per annum. In contrast the variance of the equal-weighted regional portfolio diversified across sectors is 85.2% squared. While the variance the equal-weighted sector portfolio diversified across regions is 95.6% squared. By the same reasoning the variance the sector and regional portfolios diversified across all the sectors and regions is simply the variance of the equal-weighted property portfolio of the sample properties 79.7% squared. The level of risk reduction for each of these diversification approaches: (1) sectors across regions, (2) regions across sectors and (3) regional and sector diversification, as a percentage of the average variance of the individual properties is therefore 40%, 33% and 44% respectively. Thus sectors diversified across regions offers greater reductions in individual risk than regional diversification across sectors. In particular the level of risk reduction for the sectors across regions is comparable with that of a portfolio spread across all regions and sectors. As a consequence the sector allocation is a much more important decision than the regional spread of the portfolio.

However, as suggested previously the results here show that the level of risk reduction is limited with as much of half the variance in an individual property due to non-systematic, or property specific, factors is still to be eliminated, even with a large number of property holding across diverse sectors and regions.. This indicates that naïve diversification is unlikely to lead to a large reduction in specific risk in a property portfolio in the UK. The implication of which is that for real estate fund managers greater care is needed in handling risk reduction in a property portfolio than is needed in other markets, and that even then a reduction in risk is very difficult to achieve.

## Conclusions

A simple method to measure the relative importance of sector and regional factor effects has been presented. In particular it has been shown that sector factors are more important than regional factors in explaining real estate returns. This implies that the sector composition of the real estate fund should be the first level of analysis in constructing and managing a real estate portfolio for three reasons. First, sector effects account for most of the variation in property returns with sector factors explaining almost three times the variability in real estate returns than regional factors. Second, titling the sector weights of a real estate portfolio leads to much larger tracking errors than regional tilts between such a portfolio and a benchmark of performance. Finally, two properties in the same sector are closer substitutes than two properties in the same region, the potential for portfolio risk reduction is therefore greater by diversifying across sectors within a region than across regions within a sector. Consequently real estate fund managers need to pay closer attention to the sector allocation of their portfolios than the regional spread.

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