Another Look at the Relative Importance of Sectors and Regions in Determining Property Returns

by

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Abstract

This paper re-examines the relative importance of sector and regional effects in determining property returns. Using the largest property database currently available in the world, we decompose the returns on individual properties into a national effect, common to all properties, and a number of sector and regional factors. However, unlike previous studies, we categorise the individual property data into an ever-increasing number of property-types and regions, from a simple 3-by-3 classification, up to a 10 by 63 sector/region classification. In this way we can test the impact that a finer classification has on the sector and regional effects.

We confirm the earlier findings of previous studies that sector-specific effects have a greater influence on property returns than regional effects. We also find that the impact of the sector effect is robust across different classifications of sectors and regions. Nonetheless, the more refined sector and regional partitions uncover some interesting sector and regional differences, which were obscured in previous studies. All of which has important implications for property portfolio construction and analysis.

Keywords: *Property returns, sector and regional effects, dummy variable regressions*

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1. Introduction

The application of formal portfolio strategies to direct investment in real estate is problematic. In particular, large lot-size, indivisibility, the lack of a centralised market place, limited information, long transaction periods and high transaction costs make property portfolio construction extremely difficult. Consequently, fund managers will naturally gravitate towards an investment strategy that builds on their skills in the real estate market. This will lead them to focus on certain sectors or regions of the market in which they have specialised knowledge or expertise. This has lead fund managers to define real estate diversification categories by sector and geographical region (see Webb, 1984, Louargand, 1992 and De Witt, 1996 among others). This kind of classification recognises that different factors are likely to influence the performance of property at both the sector and regional level. Indeed, there are some obvious benefits associated with targeting sectors and regions. First, it is a more disciplined and more systematic approach to portfolio construction than the traditional "building-by-building" approach (McNamara, 1990). Secondly, compared with the deal-driven acquisition process, it is more proactive as those fund managers who target certain sectors or regions can better utilise local market intelligence on investment possibilities, instead of waiting for deals to arrive. Third, it is likely gives the fund managers more control over strategy implementation, as once particular sectors and regions are targeted as they can exercise greater control over the acquisition and disposal process. Fourth, it may enhance performance, as all else being equal, if the fund manager can pick the improving sectors and regions and more especially avoid the deteriorating ones consistently, the performance of the fund should be enhanced. Finally, a targeted sector and regional methodology complements the "top-down" approach to portfolio construction. For the fund manager the question then becomes one of investigating whether sector or regional effects are the main drivers of performance and so establish the first level of analysis in portfolio construction and evaluation.

The question as to whether sectors are relatively more important than regions in determining returns is similar to that previously investigated in the international equity market when discussing the relative importance of country and industrial factors in international security returns; see for example, Beckers et al (1992), Grinold et al (1989), Heston and Rouwenhorst (1994, 1995), and Beckers et al (1996) among others. These studies use simple dummy variables to identify the industry and country affiliation of each stock. Thus, when these dummy variables are regressed on the cross-section of security returns, the estimated coefficients on the dummy variables are the implicit, or pure, return effects of the country and industry factors.

Three studies have applied this approach to the real estate market, Fisher and Liang (2000), Lee (2001) and Newell and Keng (2003). Fisher and Liang (2000) used the dummy factor approach to decompose the returns of US real estate into 4 sectors and 4 regions. Using quarterly returns fom the NCREIF database over the period 1978:Q1 to 1999:Q4, the authors found that the average cross-correlation of the pure sector indices was lower than the average cross-correlation of the regional effects. In addition, the pure sector indices, which are diversified across the regions, had higher tracking errors than the pure regional indices, which are diversified across the sectors. Both results suggest that sector diversification is more effective than regional diversification. Lee (2001) used the total returns from 326 locations (essentially towns) in the UK over the period 1981 to 1995 to decompose property returns into 3 property-types: Retail, Office and Industrial and 11 standard regions; London, South East, South West, East Anglia, East Midlands, West Midlands, Yorkshire and Humberside, North West, the North, Scotland, and Wales. Following the literature, Lee (2001) used a number of different metrics to quantify the importance of sector and region effects and found that on all criteria the sector effects were relatively more important than the regional factors in determining property returns. More precisely, the average absolute value of the sector coefficients was more than twice as large as the regional effects, while the average pure sector-specific variance was more than double that of the pure regional-specific effects. This result was confirmed by the average adjusted R^2 values, with the sector effects accounting for 22% of the variation in property returns over this period, while pure regional effects accounted for only 8%. In other words, sector effects explained almost three times the variation in property return than regional factors. Finally, Newell and Keng (2003) used quarterly data over the period 1995Q1 to 2002Q2 to test the significance of property sector and geographical diversification in Australian institutional property portfolios. Using the Heston and Rouwenhorst (1994) approach for 3 sectors and 3 regions Newell and Keng (2003) found that the results for Australia do not support the results of Fisher and Liang (2000) and Lee (2001), with the pure-regional effect showing marginally greater effect than the sector-specific effect.

This paper extends these studies in two ways. First, it uses a much broader data set that covers up to 12,767 properties. We use this data to estimate a dummy-variable factor model of property returns similar to that used in previous studies. Specifically, the model distinguishes between three kinds of factors: a national effect that captures broad co-movement across property returns in the UK, in effect controlling for the property cycle; pure sector-specific effects that control for property-type determinants of property returns; and regional-specific effects, which reflect the different characteristics of the local market. However, unlike previous studies we categorise the individual property data into an ever-increasing number of property-types and regions, from a simple 3-by-3 classification (3 sectors and 3 regions), up to 10 sectors and 63 regions. In this way we can test the impact that a finer regional classification has on the sector factors.

Second, we use this model to produce four statistical criteria against which the relative importance of sector and regional factors in determining property returns can be assessed. We begin by calculated the absolute average of the sector and regional coefficients. Next, we examined the amount of variation explained by the time series of estimated sector and regional coefficients. Then, we examined the average adjusted R-squared values of the individual impact of the sector and regional dummies on property returns. Finally, we measure the statistical significance of the dummies by calculating t-statistics.

The main results are as follows: sector influences have a greater influence on property returns than regional effects. Sector diversification explains on average 6% of the variability of property returns compared with 4% for the regional factors. The impact of the sector effect is also robust across different classifications of sectors and regions. Nonetheless, the more refined sector and regional partitions uncover some interesting sector and regional differences, which were obscured in previous studies.

The remainder of the paper is structured as follows. The next section gives details of the dummy variable model of Heston and Rouwenhorst (1994). The third section describes the data. Section four presents the initial results for the simple 3-by-3 classification used in previous studies. Then section five tests whether the results are robust to more refined classifications of regions. Section six repeats the analysis but uses a much broader classification of the sectors. Then the next section tests the robustness of the results over time. Section eight discusses the implication for the development and management of a real estate portfolio selection strategy. The final section presents the conclusions and suggests further areas of research.

2. Method

Following Heston and Rouwenhorst (1994) the model assumes that the return on each property depends on four components: a national factor (α), sector factors (β), regional factors (γ) and a property-specific disturbance (ε). Hence, the return on property i that belongs to property-type j and region k is given by:

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

where:

R_i	= the return of property i in time period t	i = 1,....N
α	= the return on the market in general	
β_j	= the return to the sector factor j	j = 1,.....M
λ_k	= the return to the regional factor k	k = 1,....L
F_j	= 1 if the property is in sector j, 0 otherwise.	
F_k	= 1 if the property is in region k, 0 otherwise	

Equation (1) is a very simple factor model of returns with dummy variables as explanatory variables (sectors and regions). The model elegantly allows for the separation of 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 of perfect multicollinearity between the regressors. The regional dummies as well as the sector dummies add up to a unit vector across properties, since every property 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. One possibility would be to arbitrarily choose one region in one sector as a base, and estimate equation (1) under the restriction that this sector and region are zero.

Rather than apply such an arbitrary sector/regional choice, Morgan (1964), Sweeny and Ulveling (SU) (1972), Suits (1984) and Kennedy (1986) have all introduced methods for presenting the results of a regression when there are several qualitative variables. Morgan (1964) illustrated the transformation for a single dummy variable with three classes using a hypothetical problem. SU extended the approach of Morgan to several dummy variables as well as explanatory variables. Suits (1984) and Kennedy (1986) present a similar transformation to that of SU. The authors all suggesting that once a restricted version of equation (1) is estimated the coefficients of the deleted sector and region can be recovered by adding a constant to each of the estimated sector and regional coefficients and subtracting the sum of the two constants from the intercept α. The constants to be added and subtracted are the proportions of the data in each sector j and region k. In a similar way the standard errors of the deleted sector/region can also be recovered, see SU (1972), Suits (1984) and Kennedy (1986) for more details.

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 α. That is once the coefficients of the dummy variables are ignored, the intercept value α 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 it has the advantage of using all the sector and regional data.

The intercept α reflects the return on the equal-weighted portfolio of the sampled property across the UK - a benchmark against which sector- and regional-specific effects are measured. Because equation (1) is estimated year-by-year, α will vary over time, capturing the impact of the UK property cycle on property returns across sectors and regions. Thus, the estimated sector and regional coefficients represent excess returns relative to this return. As long as no two sectors in the sample have exactly the same proportion of properties across the regions there is no identification problem in estimating these regionally neutralised sector effects and sector-neutralised regional effects simultaneously. 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 a greater amount than in most other regions, then the Scottish regional factor return will be positive.

This approach also allows us to decompose 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 property portfolio R_j can be decomposed into a national factor common to all regions, α, a sector-specific factor, β_j, and the average of the regional effects of the properties that make up the sector,

$$R_j = \hat{\alpha} + \hat{\beta}_j + \frac{1}{L_j}\sum_{i}\sum_{k=1}^{L}\hat{\lambda}_k F_{ik} \tag{2}$$

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

In a similar way, the actual return of a regional portfolio R_k can be broken down into a national factor common to all sectors, α, a regional-specific component λ_k, and the average of the sector-specific effects of the properties that make up the sector,

$$R_k = \hat{\alpha} + \frac{1}{M_k}\sum_i \sum_{j=1}^{M} \hat{\beta}_j F_{ij} + \hat{\lambda}_k \qquad (3)$$

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

Equation (2) shows that there are two reasons that sector performance differs from that of the national portfolio. The first is that regional composition differs across sectors. The second is the sector effect itself, which accounts for differences in the return on properties in sector j relative to properties in the same region but located in another sector. In a similar vein, equation (3) shows that the returns of a regional portfolio can differ from that of a UK wide market portfolio for two reasons; first because the sector composition of the regional market is different from the sector composition of the market as a whole, and/or the return on properties in region k are different from that of other properties which are in the same sector but located in a different region.

The relative importance of the sector and regional factors in determining property returns in the UK is measured using four statistical criteria. First, the contribution of the individual factors in determining property returns, once one of the variables is omitted is compared with that of the full model, as measured by adjusted R^2 (see Beckers et al 1996). The difference in the cross-section of explanatory powers then measures the contribution of the omitted variable to explaining returns in a given period t. Second, the average absolute values of the sector and regional coefficients are compared (Heston and Rouwenhorst, 1995, and Rouwenhorst, 1999). If the mean of the absolute values of the regional effects is smaller than that of the sector effects over a given period, this is indicative of a lower importance of regions relative to sectors during that period. Third, the relative importance of the distinct factors can be measured by the time-series volatility of the factor estimates (Heston and Rouwenhorst, 1995). As the factor loadings in the model are either zero or unity, the explanatory power of a factor can be simply measured by the factor return variance. So if the variance of the sector effects is greater than that of the regional effects, this is indicative of the greater importance of sectors in determining returns during that period.

3. Data

Central to this paper is that the data be a realistic and unbiased representation of the performance of property in the UK. The IPD database provides such a source. IPD is a commercial organisation that provides independent performance measurement and benchmarking services to property investors. Their databases are made up from individual property data provided by contributing investors. There were 236 funds contributing to the UK database at the end of 2001 (IPD, 2002a). These included insurance companies, pension funds and quoted property companies. The number of properties covered was

12,000 with an aggregate value of £98.5 billion - equivalent to two-thirds of the total property assets of UK institutions and listed property companies (IPD, 2002b). Such a large dataset is ideally suited to the approach of Heston and Rouwenhorst (1994).

The data used in this study is essentially all standing investments in the IPD database. These are properties that are held in portfolios and not bought or sold, or subject to development or significant improvement expenditure during the period. However, properties that did not belong to one of the three main sectors (Retail, Office and Industrial) were excluded from the analysis. These were typically investments in such sectors as agricultural land and leisure, which do not form a significant part of most institutional portfolios. It is also worth noting that, in the UK, residential property is not a large part of institutional portfolios either. Even with these restrictions, there are still yearly total returns for up to 12,767 properties over the period 1981 to 2001.

Such a large database can then be categorised into various sector and regional groupings. The simplest classification is that suggested by Eichholtz et al (1995) and Lee and Byrne (1998), which classifies the UK property market into 3 sectors; retail, office, industrial and 3 super-geographical regions; London, the rest of the southeast and the rest of the UK. However, such a broad geographical classification is not refined enough to test whether the dominance of the sector effect found in previous studies is robust to different regional classifications. We therefore test the 3-sector classification against two more fined regional classifications. First, a 16 regional classification scheme was tested based on the categories found in the IPD *Property Investors' Digest* (IPD, 2002b). These are essentially the 11 standard regions of the UK, as defined by the UK government, with London broken down into five further areas to reflect the dominance of London in institutional property portfolios. This classification is similar to that used by Lee (2001). Secondly, the three sectors were compared against 63 regions (essentially counties) of the UK.

However, the classification of sectors has evolved significantly over the years. Therefore, the specific sectors studied may also affect the results. The analysis was therefore repeated with 10 sectors rather than 3. The 10 sectors are; standard shops, shopping centres, retail warehouses, department/variety stores, supermarkets, other retail, standard offices, standard industrial, industrial parks and distribution warehouses. This broader sector classification was then compared with the 3, 16 and 63 regions[1].

4. The Relative Importance of Sector/Regional Effects

3 Sectors by 3 Regions

The decomposition of the excess sector and regional portfolio returns for the 3-by-3-classification scheme is shown in Table 1. To determine the relative importance of the sector and regional effects, we examine a number of statistics derived from the cross-section regressions. First, we calculated the absolute average of the sector and regional coefficients. Second, we examine the amount of variation explained by the time series of estimated sector

[1] All the handling and processing of individual property data was done by IPD to maintain investor confidentiality.

and regional coefficients. Third, we examined the average R-squared values of the individual impact of the sector and regional dummies on property returns over the 21-years.

Table 1: The Decomposition of Excess Returns into 3 Sectors and 3 Regions Annual Returns 1981-2001

Sector	Excess Coefficient	Pure Sector Variance	Ratio to market	Cumulative Reg Variance	Ratio to market
Retail	0.33	8.07	0.96	0.16	0.02
Office	-0.99	8.41	0.77	0.78	0.09
Industrial	1.30	25.63	1.03	0.13	0.00
Absolute Average	0.87	14.03	0.92	0.35	0.04
Region	**Excess Coefficient**	**Pure Regional Variance**	**Ratio to market**	**Cumulative Sect Variance**	**Ratio to market**
London	0.94	9.51	0.81	0.69	0.07
Rest of SE	-0.85	1.05	1.23	0.07	0.07
Rest of UK	0.06	3.51	0.89	0.32	0.09
Absolute Average	0.61	4.69	0.97	0.36	0.08
Sector Adj R-Squared	4.97				
Regional Adj R Squared	2.01				

Table 1 shows a number of features of interest. First, there is a wide divergence in returns across sectors even after controlling for the common national factor and the "pure" regional effects. There is a strong positive "pure" sector effect in the standard industrials, while the sector effect is not surprisingly very negative for the office market. In a similar way, the excess returns of the "pure" regional factors shows a large spread, after controlling for any sector effects. For instance, the South East showed a strong negative "pure" regional factor, while London showed an extremely strong positive "pure" regional effect. Second, there is considerable cross-sectional variation in the total variances of the sector component. The Retail sector has the least sector effect variance (8.07^2) closely followed by Offices with Industrial showing by far the largest sector effects (25.63^2). The ratio of these variances to the actual returns of the sectors (presented in column 4) show that almost all the variance in the actual returns can be explained by these pure sector returns. Indeed, the cumulative regional-effect variance can explain on average only 4% of the total variance of the sector indexes. In particular, properties in the Retail and Industrial sectors do not appear to be influenced by regional considerations. In contrast, Offices show some evidence of a regional dimension with a ratio of 0.77 and a cumulative regional effect of 9%. These results confirm those of Cullen (1993) who found that Industrial property is relatively homogenous across the UK, while Retail properties are partitioned more on ownership and lease terms rather than on any regional basis, whereas the Office market displayed a distinct geographical structure. These results are also in line with work of Hoesli, et al (1997) and Hamelink, et al (2000) who found that there appears to be a geographical dimension to the Office and Industrial markets but none for the Retail sector.

From the findings in Panel B of Table 1 we can compare the relative importance of the "pure" regional and sector factors. The London region has the largest regional-effect variance by far (9.51^2). Implying that the London region is somewhat different from the others, confirming the observations of Cullen (1993) and Hamelink et al (2000). When we compare the absolute average of the sector coefficients (0.87) to that for the regional coefficients (0.61), we find a ratio of 1.4:1. This suggests that sector effects are more important than regional effects in determining property returns. In a similar vein, when we compare the average variance of the sectors (14.03^2) to the average variance of the regional effects (4.69^2), we find a ratio of 3:1, which is considerably greater than that of Lee (2001) who found a ratio of 2:1. However, as shown in the last column of Table 1, the cumulative sector-effect variances can explain on average only 8% of the total variance of the regional indexes. This is half that reported by Lee (2001). Finally, the adjusted R^2 statistics show that the sector effects (4.97) account for more than twice the regional effects (2.01) in determining returns. All the results confirm the findings of Fisher and Liang (2000) and Lee (2001). We can thus conclude that for the 3-by-3-classification scheme, the sector effects are more important in determining returns than regional factors.

5. Tests Using a More Refined Regional Classification

A key hypothesis that we test is whether the dominance of the sectors over the regions is robust to the definition of a region. This is examined by expanding the classifications of the individual properties up to 63 regions, with the results presented in Tables 2 and 3.

3 Sectors and 16 Regions

Table 2 presents the results for the 3-by-16-classification and it shows some interesting features. First, the results for the excess coefficients and variances of the 3 sectors are virtually identical to those in Table 1. Second, Offices now show an even stronger regional dimension than before, with the cumulative regional-specific effects explaining 28% of the pure-sector index, whereas the regional impact on the other sectors is negligible. However, the cumulative regional-effect variance explains only 12% of the total variance of the sector indices, which is the same as that found by Lee (2001). In contrast, the cumulative sector-effect variance explains on average 45% of the total variance of the regional indices. This is almost four times that shown in Lee (2001). The average R^2 is 5% for the sector factors and only 3.7% for the regional effects, whereas Lee (2001) reports a value of 22% for the sector effects and 8% for the regional factors. However, this result is to be expected because this study is based on individual level data whereas the study by Lee (2001) used town level data. The town level portfolios would have eliminated much of the property specific risk of the individual property data. Consequently, it is not surprising to see the average R^2 figures are much lower in this study than in previous work.

Panel B of Table 2 shows the results for the regional dummies. It will be noticed that a number of pure-regional variances are considerably greater than that of a number of pure-sector variances. For instance, the Inner London regions (The City, Mid-town and the West End) and Northern Ireland all show time series variances of their regression coefficients that are much greater than that for all the sectors. This implies that the regions need to be defined with greater precision in order to draw out the true regional impact. This is confirmed by the percentage of significant t-statistics for these regions, especially Northern Ireland. In contrast, the regions of middle England show no significant regional factors. In terms of the absolute average of the excess coefficients the regional factors (1.11) are stronger than sector factors (0.97). This, however, is largely due to the effect of Northern Ireland. Once Northern Ireland is discounted, the absolute average of the regional factors falls to 0.79. This result implies that the sector and regional effects are of equal importance in determining property returns. A result confirmed by the average variance of the sector effects at 13.99^2 compared with 15.26^2 (14.11^2) for the regional factors, including and excluding Northern Ireland. Nonetheless, the coefficient of determination (R^2) of the pure-sector factors is still 35% greater than that for the pure-regional factors, even with 16 regions. We can thus conclude that for the 3-by-16-classification scheme the sector effects are still more important in determining returns than regional factors.

Table 2: The Decomposition of Excess Returns into 3 Sectors and 16 Regions Annual Returns 1981-2001

Sector	Excess Coefficient	Pure Sector Variance	Ratio to market	Cumulative Reg Variance	Ratio to market
Retail	0.36	8.54	1.02	0.43	0.05
Office	-1.13	8.77	0.81	2.43	0.28
Industrial	1.42	24.66	0.99	0.63	0.03
Absolute Average	0.97	13.99	0.94	1.17	0.12
Region	**Excess Coefficient**	**Pure Regional Variance**	**Ratio to market**	**Cumulative Sect Variance**	**Ratio to market**
City	0.12	62.94	1.10	14.30	0.23
Mid-town	2.49	42.64	0.82	13.30	0.31
West end	1.80	32.12	0.96	7.41	0.23
Inner London	2.80	17.13	0.76	4.32	0.25
Outer London	0.07	1.68	0.62	1.87	1.11
South East	-0.90	1.40	0.48	1.76	1.26
South West	-0.38	2.24	0.46	1.47	0.66
Eastern	-0.77	1.16	0.48	1.32	1.14
East Midlands	0.52	3.39	0.61	1.13	0.33
West Midlands	-0.20	5.04	0.72	1.01	0.20
Yorks & Humberside	0.18	4.05	0.61	1.66	0.41
North East	0.35	6.31	0.71	1.59	0.25
North West	0.06	13.30	0.83	2.23	0.17
Scotland	-0.36	10.68	0.90	0.89	0.08
Wales	0.90	7.59	0.97	3.39	0.45
Northern Ireland	5.89	32.47	0.92	2.73	0.08
Absolute Average	1.11	15.26	0.75	3.77	0.45
Absolute Average[1]	0.79	14.11			
Sector Adj R-Squared	4.97				
Regional Adj R Squared	3.68				

Note: 1 excluding Northern Ireland

3 Sectors and 63 Regions

Table 3 presents the results for the 3-by-63-classification scheme of the individual property data. It shows that the excess sector coefficients are virtually identical to those in Tables 1 and 2. Any difference is due to the use of fewer data points, as only those counties with more than ten properties were included in the analysis, in order to make sure there are enough representative properties for each region. For instance, if there were only a single property in a given county, then estimating a "pure" regional factor would not be relevant. We therefore require that there be at least ten properties belonging to any county for any given year. If there are less than ten, then the county is dropped and the corresponding properties have no regional exposure (in which case part of the regional effect, if there is any, will be found in the properties specific return $\varepsilon_{i,t}$).

The results in Table 3 show that moving to a finer classification scheme significantly changes the results for the sector effects. The cumulative regional impact is now 203% compared with 4% and 8% in Tables 1 and 2. The impact is greatest for the Office and Industrial sectors and least for Retail. This implies that Office and Industrial properties show a strong regional dimension whereas Retail properties are differentiated on other factors, again confirming the findings of Hoesli, et al (1997) and Hamelink et al (2000). In addition to which, the 3-sector classification scheme is significantly contaminated by the finer level of regional classification and consequently cannot be considered as representative of the sector dimensions of property returns in the UK. Nonetheless, the absolute average of excess sector coefficients (1.01) and the average R^2 of the sector effects (4.97%) are both greater than that of the regional effects (0.90 and 4.57% respectively).

Panel B of Table 3 shows that moving to a more refined regional classification adds nothing to the average variance of the regional-specific effects compared with the 16 sectors shown in Table 2. Indeed, the absolute average of the regression coefficients for the regional impact is slightly less for the 63 regional classification scheme (0.90) compared with the 16 regions (1.11), while the variance of the pure regional-specific effect is 13.03^2 compared with 15.26^2. Nonetheless, Table 3 provides strong support for the findings in Table 2, emphasising the view that the three inner London areas of The City, Mid-Town and the West End are significant "property regions" in their own right and as a result need to be analysed by specialists in these markets. Table 3 also suggests that the rest of England up to the Northern regions can be considered as one area for analytical purposes. This conclusion is supported by the lack of significant t-statistics for these areas. Finally, Table 3 shows that the Northern Regions (North East and North West), Scotland, Wales and Northern Ireland are property areas that need extra care as the regional impact in these areas dominates any property sector effects. The cumulative sector effect impact is now 20% on average compared with 45% for the 16 regional classification scheme.

Table 3: The Decomposition of Excess Returns into 3 Sectors and 63 Regions Annual Returns 1981-2001

Sector	Excess Coefficient	Pure Sector Variance	Ratio to market	Cumulative Reg Variance	Ratio to market
Retail	0.39	8.25	0.82	0.89	0.11
Office	-1.20	8.45	0.93	29.39	3.48
Industrial	1.43	24.09	0.65	60.66	2.52
Absolute Average	1.01	13.60	0.80	30.31	2.03
Region	**Excess Coefficient**	**Pure Regional Variance**	**Ratio to market**	**Cumulative Sect Variance**	**Ratio to market**
City	0.18	62.40	0.87	24.20	0.39
Mid Town	2.53	42.72	0.82	4.37	0.10
West End	1.84	32.21	0.94	1.34	0.04
Inner London	2.83	17.23	0.82	0.99	0.06
Outer London	0.07	1.63	1.05	0.06	0.04
Berkshire	-1.26	5.63	1.60	0.82	0.15
Buckinghamshire	-0.41	2.94	0.75	1.44	0.49
Hampshire	-0.67	2.87	1.30	0.31	0.11
East Sussex	-1.13	4.45	0.64	1.27	0.29
Kent	-0.77	3.78	1.40	0.60	0.16
Oxfordshire	-0.13	2.22	1.13	0.29	0.13
Surrey	-0.87	3.95	0.94	0.34	0.08
West Sussex	-1.49	3.00	0.76	0.22	0.07
Avon	-0.13	4.22	0.76	0.26	0.06
Cornwall	-0.20	6.97	0.35	6.09	0.87
Devon	-0.23	4.67	0.84	1.18	0.25
Dorset	-0.98	2.81	0.55	1.37	0.49
Gloucestershire	0.13	4.85	0.82	0.41	0.08
Somerset	-1.33	9.30	0.57	2.76	0.30
Wiltshire	-0.28	5.40	1.27	0.26	0.05
Bedfordshire	-1.44	3.00	0.51	1.22	0.41
Cambridgeshire	0.34	3.42	0.82	0.60	0.17
Essex	-0.63	2.83	1.01	0.44	0.15
Hertfordshire	-1.19	3.82	1.30	0.93	0.24
Norfolk	-0.63	5.22	0.67	1.10	0.21
Suffolk	-0.98	6.43	0.64	1.28	0.20
Cheshire	-0.54	5.14	0.61	2.02	0.39
Derbyshire	0.86	6.44	1.00	0.80	0.12
Leicestershire	1.10	7.40	0.93	0.35	0.05
Lincolnshire	-0.66	7.89	0.49	3.41	0.43
Nottinghamshire	0.80	5.19	0.99	0.33	0.06
West Midlands	0.07	10.75	0.82	0.41	0.04
Hertfordshire/Worcestershire	-0.09	3.88	0.76	1.77	0.46
Northamptonshire	0.18	4.59	0.60	0.75	0.16
Shropshire	-0.58	6.72	0.82	1.14	0.17
Staffordshire	-0.15	6.09	0.89	0.88	0.14
Warwickshire	-0.78	3.83	1.01	1.09	0.29
Humberside	1.68	13.24	0.85	2.32	0.18
North Yorkshire	0.34	6.62	0.35	5.26	0.79
South Yorkshire	-0.18	6.94	1.08	0.58	0.08
West Yorkshire	0.19	10.33	0.84	0.28	0.03
Merseyside	1.18	11.53	0.92	0.89	0.08
Tyne and Wear	0.98	19.57	1.09	0.64	0.03
Durham	-0.57	8.84	0.49	3.44	0.39
Northumberland	1.49	25.63	0.70	3.74	0.15
Cleveland	-1.21	26.32	0.86	2.46	0.09
Cumbria	0.80	12.94	0.59	5.07	0.39
Greater Manchester	0.80	10.75	1.01	0.08	0.01
Lancashire	-0.22	5.38	0.56	2.30	0.43
Clwyd	0.61	14.32	0.48	4.75	0.33
Dyfed	1.39	21.99	0.66	7.82	0.36
Gwent	3.00	58.05	1.34	3.61	0.06
Mid Glamorgan	1.86	6.78	0.94	1.56	0.23
South Glamorgan	-0.74	20.86	1.02	0.06	0.00
West Glamorgan	0.43	14.61	0.76	2.55	0.17
Central Region	-0.12	19.04	0.84	2.79	0.15
Fife Region	-0.63	20.15	1.00	2.66	0.13
Grampian Region	-0.63	66.39	1.11	2.09	0.03
Highland Region	-0.47	34.05	0.82	2.15	0.06
Lothian Region	0.68	11.79	0.75	0.67	0.06
Strathclyde Region	-0.55	11.15	0.99	0.09	0.01
Tayside Region	-1.67	14.83	0.72	2.03	0.14
Northern Ireland	5.88	32.58	1.00	0.56	0.02
Absolute Average	0.90	13.03	0.85	2.02	0.20
Sector Adj R-Squared	4.97				

Regional Adj R Squared	**4.57**

6. Tests Using a More Refined Sector Classification

As shown above, the three-sector classification scheme is robust to wider definitions of regions. The relative contribution of the sector and regional effect is in part determined by the degree of integration among the sectors. For instance, the studies of Fisher and Liang (2000), Lee (2001) and Newell and Keng (2003) used only 4, 3 and 3 sectors respectively to show the dominance of the sector effect. However, the classification of sectors has evolved significantly over the years with "new" sectors beginning to be identified, especially within the Retail and Industrial sectors. Therefore, the specific sectors studied may affect the results. The following section repeats the analysis above but uses 10 sectors rather than 3.

10 Sectors and 3 Regions

Table 4 presents some interesting results. First, there is considerable cross-sectional variation in the total variances of the sector component. The Retail Warehouse (RW) and Distribution Warehouses (DW) have the largest sector effect variances (35.05^2 and 36.01^2, respectively) while Shopping Centres and Standard Offices have the smallest (7.74^2 and 8.41^2, respectively). This implies that the performance of RW and DW is driven by sector considerations, whereas Shopping Centres and Standard Offices are more influenced by regional effects as shown by the second to last column of Table 4. Nonetheless, the cumulative regional-effect variance can explain on average only 4% of the total variance of the sector indices. This ratio is considerably lower than the 12% average found by Lee (2001). The use of a broader classification of sectors has also affected the percentage of cross sectional coefficients that are significant at the 5% level. The average falling to only 39% compared with more than 80% in Tables 1-3, with only Industrials showing a significant sector factor for the majority of the time. Indeed, the results in column 7 show that the sector effect is generally only significant in about half of the 21 periods and for some sectors less than a third of the time. Shopping Centres show the least sector effect, which is concentrated in the market booms of 1988-1989 and 2000. This confirms the view above that Shopping Centres are driven more by regional effects than any of the other property-types. Together, these results imply that the significant of the sector effect is dependent on the level of categorisation and varies considerably over time.

When the findings of Panel B of Table 4 are compared with the results in Panel A, it is clear that the sector-specific effects explain more about property returns than the regional-specific effects. First, the average absolute of the excess regression coefficients of the sectors (0.95) is more than 50% greater than the regional values (0.62). Second, the pure sector variance (18.15^2) is almost four times that of the pure regional variance (4.66^2), while the average R^2 of the sector factors (6.17%) is three times greater than that of the regional factors (2.02%). In addition, Panel B of Table 4 shows that the finer sector classification has a significant impact on the 3 regions. The regional factors explain only 10% of the property returns, while the cumulative sector effects explain most of the regional indexes. This implies that the 3-region scheme is severely contaminated by sector effects and as a consequence does not provide a viable classification of regions in the UK.

Table 4: The Decomposition of Excess Returns into 10 Sectors and 3 Regions Annual Returns 1981-2001

Sector	Excess Coefficient	Pure Sector Variance	Ratio to market	Cumulative Reg Variance	Ratio to market
Standard Shops	-0.07	9.75	0.98	0.13	0.01
Shopping Centres	-0.98	7.74	0.87	1.06	0.14
Retail Warehouses	2.05	35.05	0.94	0.40	0.01
Dept/Variety Stores	0.61	12.64	0.90	0.57	0.04
Supermarkets	1.24	14.34	0.87	0.33	0.02
Other Retail	0.86	8.45	1.10	0.14	0.02
Standard Office	-1.00	8.41	0.77	0.78	0.09
Standard Industrial	1.47	26.62	1.03	0.11	0.00
Industrial Parks	0.58	22.48	1.06	0.29	0.01
Distribution Warehouses	0.63	36.01	0.92	0.35	0.01
Absolute Average	0.95	18.15	0.94	0.41	0.04
Region	**Excess Coefficient**	**Pure Regional Variance**	**Ratio to market**	**Cumulative Sect Variance**	**Ratio to market**
London	0.95	9.48	0.17	30.00	3.16
Rest of SE	0.86	1.03	0.02	57.72	56.13
Rest of UK	0.06	3.48	0.10	53.28	15.32
Absolute Average	0.62	4.66	0.10	47.00	24.87
Sector Adj R-Squared	6.17				
Regional Adj R Squared	2.02				

10 Sectors and 16 Regions

Table 5 presents the results for the 10 sectors and the 16 regions. The results for the excess coefficients and variances of the sectors are virtually identical to those in Table 4, with any difference due to rounding error. However, moving to a finer regional classification highlights a number of regional impacts on the sectors. For instance, the second to last column of Table 5 shows that the cumulative regional-specific effects explain 24% and 28% of the total variance of the Shopping Centre and Standard Office sector indices, whereas the regional impact on the other sectors is negligible. This confirms the findings in Table 4 with respect to those sectors. The use of a more refined regional classification has also increased the average percentage of significant the t-statistics (41%). This implies that the 10-sector classification scheme is better described by this broader regional classification scheme. The impact is especially noticeable in the RW sector where two more years are now significant. Nonetheless, for the majority of the property-types, the sector effect is still significant for less than half of the time.

Table 5 shows that moving to a 16 regional classification scheme has had a large impact on the results for the regions. The cumulative sector effect now falls to 45%. In addition, a number of pure-regional variances are considerably greater than that of a number of pure-sector variances. For instance, the Inner London regions (The City, Mid-town and the West End) the North East, Scotland and Northern Ireland all show time series variances of their regression coefficients that are much greater than shopping centres, other retail and standard offices. The results for the t-statistics confirm this and suggest that the regional effect needs to be defined with greater precision in order to draw out the regional impact. In terms of the absolute average of the excess coefficients, the regional factors (1.11) are stronger than sector factors (1.02), but again this is largely due to the effect of Northern Ireland. Once Northern Ireland is discounted, the absolute average of the regional factors falls to 0.81. Implying that sector effects are more important than regional effects in determining property returns. This result is confirmed by the average variance of the sector effects at 17.95^2 compared with 15.28^2 (14.12^2) for the regional factors, including and excluding Northern Ireland. The coefficient of determination (R^2) of the pure-sector factors (6.17%) is still 66% greater than that for the pure-regional factors (3.70%).

Table 5: The Decomposition of Excess Returns into 10 Sectors and 16 Regions Annual Returns 1981-2001

Sector	Excess Coefficient	Pure Sector Variance	Ratio to market	Cumulative Reg Variance	Ratio to market
Standard Shops	-0.03	10.32	1.03	0.38	0.04
Shopping Centres	-0.91	7.53	0.84	1.82	0.24
Retail Warehouses	2.19	34.73	0.93	0.98	0.03
Dept/Variety Stores	0.61	12.63	0.90	1.03	0.08
Supermarkets	1.40	14.00	0.85	0.57	0.04
Other Retail	0.79	9.44	1.23	0.18	0.02
Standard Office	-1.16	8.74	0.81	2.45	0.28
Standard Industrial	1.62	25.70	0.99	0.63	0.02
Industrial Parks	0.73	21.72	1.03	0.59	0.03
Distribution Warehouses	0.73	34.71	0.89	0.86	0.02
Absolute Average	1.02	17.95	0.95	0.95	0.08
Region	**Excess Coefficient**	**Pure Regional Variance**	**Ratio to market**	**Cumulative Sect Variance**	**Ratio to market**
City	0.14	63.09	1.11	14.41	0.23
Mid-town	2.56	42.92	0.83	13.69	0.32
West end	1.94	32.03	0.96	7.93	0.25
Inner London	2.84	16.91	0.75	4.64	0.27
Outer London	0.00	1.64	0.60	1.86	1.14
South East	-0.91	1.33	0.45	1.78	1.34
South West	-0.36	2.21	0.45	1.51	0.68
Eastern	-0.81	1.23	0.51	1.29	1.04
East Midlands	0.50	3.23	0.58	1.14	0.35
West Midlands	-0.24	5.01	0.72	0.97	0.19
Yorks & Humberside	0.19	4.06	0.61	1.66	0.41
North East	0.04	13.32	0.83	2.00	0.15
North West	0.38	6.33	0.71	1.55	0.25
Scotland	-0.33	10.70	0.90	0.89	0.08
Wales	0.87	7.74	0.99	3.22	0.42
Northern Ireland	5.71	32.76	0.93	2.50	0.08
Absolute Average	1.11	15.28	0.75	3.81	0.45
Absolute Average[1]	0.81	14.12			
Sector Adj R-Squared	6.17				
Regional Adj R Squared	3.70				

Note1: excluding Northern Ireland

10 Sectors and 63 Regions

Table 6 presents the results for the 10-sector and 63-region classification scheme and shows some interesting features. First, the cumulative regional impact is now 17% overall. Second, the cumulative regional impact on Shopping Centres shown in the last column of Table 5 (24%) has now been virtually eliminated (4%). Thus, apart from Other Retail, the retail sector does not exhibit a regional dimension, in line with the findings of Cullen (1993), Hoesli, et al (1997) and Hamelink, et al (2000). In contrast, the regional impact on Standard Offices has been strengthened, increasing from 28% to 101%. This is probably due to the breakdown of the Standard Regions outside London into a more refined classification. In other words, Standard Offices show an extremely large regional effect. In contrast, the Industrial sector now has no regional impacts. These results for Retail, Office and Industrial confirm the findings of Cullen (1993), Hoesli, et al (1997) and Hamelink, et al (2000).

Table 6: The Decomposition of Excess Returns into 10 Sectors and 63 Regions Annual Returns 1981-2001

Sector	Excess Coefficient	Pure Sector Variance	Ratio to market	Cumulative Reg Variance	Ratio to market
Standard Shops	-0.01	9.89	0.90	0.96	0.10
Shopping Centres	-0.91	7.79	1.07	0.31	0.04
Retail Warehouses	2.19	34.59	1.00	0.50	0.01
Dept/Variety Stores	0.71	11.79	0.97	0.38	0.03
Supermarkets	1.49	13.36	1.12	0.84	0.06
Other Retail	0.71	9.90	1.17	3.14	0.32
Standard Office	-1.22	8.42	0.50	8.51	1.01
Standard Industrial	1.63	25.11	0.99	0.78	0.03
Industrial Parks	0.77	21.73	1.07	1.30	0.06
Distribution Warehouses	0.68	35.69	1.10	0.75	0.02
Absolute Average	1.03	17.83	0.99	1.75	0.17
Region	**Excess Coefficient**	**Pure Regional Variance**	**Ratio to market**	**Cumulative Sect Variance**	**Ratio to market**
City	-0.37	81.41	1.10	7.46	0.09
Mid Town	2.03	62.13	0.88	4.36	0.07
West End	1.40	48.23	0.96	1.48	0.03
Inner London	2.30	28.01	0.87	1.09	0.04
Outer London	-0.56	4.26	1.01	0.07	0.02
Berkshire	-1.78	7.94	1.36	0.82	0.10
Buckinghamshire	-1.06	4.47	0.82	1.62	0.36
Hampshire	-1.31	2.78	1.32	0.30	0.11
East Sussex	-1.64	3.65	0.58	1.33	0.36
Kent	-1.42	5.09	1.27	0.61	0.12
Oxfordshire	-0.64	4.03	1.08	0.28	0.07
Surrey	-1.40	6.65	0.96	0.39	0.06
West Sussex	-1.98	4.10	0.80	0.25	0.06
Avon	-0.67	5.11	0.80	0.26	0.05
Cornwall	-0.75	7.89	0.38	6.40	0.81
Devon	-0.75	7.89	0.38	6.40	0.81
Dorset	-1.61	2.09	0.47	1.39	0.66
Gloucestershire	-0.32	4.13	0.79	0.42	0.10
Somerset	-1.76	8.04	0.54	2.72	0.34
Wiltshire	-0.86	5.30	1.55	0.47	0.09
Bedfordshire	-2.30	3.85	0.61	1.61	0.42
Cambridgeshire	-0.23	5.80	0.91	0.62	0.11
Essex	-1.30	3.97	1.05	0.54	0.14
Hertfordshire	-1.76	7.03	1.18	1.00	0.14
Norfolk	-1.12	4.21	0.58	1.19	0.28
Suffolk	-1.53	4.84	0.58	1.29	0.27
Cheshire	-1.00	3.36	0.49	1.95	0.58
Derbyshire	0.35	3.75	0.97	0.87	0.23
Leicestershire	0.50	6.24	0.87	0.50	0.08
Lincolnshire	-1.23	6.77	0.46	3.14	0.46
Nottinghamshire	0.22	4.54	1.02	0.41	0.09
West Midlands	-1.30	3.97	1.05	0.54	0.14
Hertfordshire/Worcestershire	-0.41	6.31	0.70	0.93	0.15
Northamptonshire	-1.25	6.27	0.82	1.27	0.20
Shropshire	-0.76	3.71	0.83	0.89	0.24
Staffordshire	-1.25	4.79	1.09	1.00	0.21
Warwickshire	-0.58	4.93	0.64	0.58	0.12
Humberside	0.90	8.25	0.79	2.34	0.28
North Yorkshire	-0.02	6.94	0.35	5.64	0.81
South Yorkshire	-0.76	3.30	1.14	0.66	0.20
West Yorkshire	-1.78	7.94	1.36	0.82	0.10
Merseyside	0.65	5.65	0.82	0.92	0.16
Tyne and Wear	0.27	10.27	1.05	0.71	0.07
Durham	-1.11	5.86	0.39	3.42	0.58
Northumberland	1.07	22.03	0.68	3.22	0.15
Cleveland	-1.62	19.32	0.83	2.24	0.12
Cumbria	0.35	10.27	0.51	5.39	0.52
Greater Manchester	0.23	4.75	0.98	0.11	0.02
Lancashire	-0.84	2.17	0.32	2.59	1.20
Clwyd	0.14	12.62	0.45	4.70	0.37
Dyfed	0.85	20.66	0.63	8.60	0.42
Gwent	2.69	56.62	1.29	3.33	0.06
Mid Glamorgan	0.98	7.75	1.12	2.10	0.27
South Glamorgan	-1.60	11.61	0.92	0.38	0.03
West Glamorgan	-0.34	14.68	0.72	2.38	0.16
Central Region	-0.58	13.55	0.81	2.68	0.20
Fife Region	-1.17	14.32	0.99	2.60	0.18
Grampian Region	-1.26	50.43	1.15	2.17	0.04
Highland Region	-1.08	27.11	0.79	2.01	0.07
Lothian Region	0.16	10.23	0.72	0.67	0.07
Strathclyde Region	-1.09	5.60	0.94	0.07	0.01
Tayside Region	-2.15	10.59	0.68	1.98	0.19

Northern Ireland	**5.14**	**20.36**	**1.02**	**0.58**	**0.03**
Absolute Average	**1.09**	**12.11**	**0.83**	**1.81**	**0.23**
Absolute Average[1]	**1.02**	**11.98**			
Sector Adj R-Squared	**6.16**				
Regional Adj R Squared	**4.57**				

Note: 1 excluding Northern Ireland

Table 6 provides further support to the findings in Table 2 that the three inner London areas of The City, Mid-Town and the West End are significant "property regions" in their own right and as a result need to be analysed by specialists in these markets. Table 6 also confirms the view that the rest of England up to the Northern regions can be considered as one area for analytical purposes. Finally, Table 6 shows that the Northern Regions (North East and North West), Scotland, Wales and Northern Ireland are property areas that need extra care as the regional impact in these areas dominates any property sector effects.

In terms of the absolute average of the excess coefficients the regional factors (1.09) are stronger than sector factors (1.03), but once again this is largely due to the effect of Northern Ireland. Once Northern Ireland is discounted, the absolute average falls to 1.02, implying that sector effects are more important than regional effects in determining property returns. This result confirmed by the average variance of the sector effects 17.83^2 compared with 12.11^2 (11.98^2) for the regional factors, including and excluding Northern Ireland. Finally, the coefficient of determination (R^2) of the pure-sector factors (6.16%) is still 35% greater than that for the pure-regional factors (4.57%), even with 63 regions

7. Sub-period Analysis

In order to see if the overall results are stable over time, the results for the individual cross-sectional regressions are presented in Table 7 for the 21 years from 1981-2001. Table 7 show the results of the sector and regional effects for the 10-by-16-classification scheme[2]. The second and third columns of Table 7 shows the adjusted R-squared values and columns four and five the mean absolute values of the sector and regional excess returns.

Table 7: Individual Cross-Sectional Results: 1981-2001

[2] The results for the other classifications are qualitatively the same and are available upon request.

	Adjusted R-Sq		Mean Absolute	
Year	Sector	Region	Sector	Region
1981	3.5	0.5	3.9	2.7
1982	4.3	0.3	3.7	2.2
1983	8.0	0.3	3.7	2.0
1984	7.3	0.7	3.6	2.2
1985	7.7	1.9	4.4	2.3
1986	2.4	5.6	2.0	2.6
1987	1.2	10.8	1.6	2.7
1988	4.8	3.4	5.9	4.2
1989	11.5	3.9	8.4	4.0
1990	2.6	4.8	2.8	3.3
1991	14.6	9.3	4.8	2.6
1992	13.5	5.9	4.7	2.8
1993	4.2	0.9	4.0	2.2
1994	1.5	3.2	2.0	2.4
1995	1.5	4.4	2.2	2.0
1996	3.8	2.4	2.1	1.4
1997	4.0	6.8	2.3	2.5
1998	3.7	2.9	1.4	2.2
1999	3.8	1.6	1.2	2.2
2000	21.2	6.4	3.2	2.2
2001	4.5	1.7	1.3	1.5

Table 7 shows a number of features of interest. First, although the dominance of the sector effect is generally robust across different periods of the property cycle, there are number of periods when the regional factor is greater than the sector effect. For instance, the adjusted R-squared value of the regional effects is generally the same or greater than that for the sector effects in 1986-1987, 1990, 1994-1995, and 1997 all periods of relative calm in the real estate market. In contrast, the sector effects are much greater than the regional effects in 1981-1985, 1988-1989, 1991-1993, 1996 and 1998-2002, all periods of market turbulence. In other words, when markets are changing rapidly, the sector effects dominate, but in periods of low return, the regional effects are of equal or greater importance. Columns four and five show a similar picture, with the mean absolute excess returns rising and falling with the property cycle. The sector effects dominate the regional factors in the early 1980s, the market boom and bust of the late 1980s and early 1990s.

8. Implications for Fund Management

The results so far have at least three implications for property fund management – the dimensions of the property portfolio, sector and regional diversification and tracking error risk.

The Dimensions of the Property Portfolio

The establishment of a meaningful classification scheme for sectors and regions in the property portfolio is important for at least two reasons. First, inappropriately defined classifications could render strategies to enhance returns meaningless. For instance, if the categorisation scheme were too widely drawn, the performance of the targeted sectors/regions is unlikely to be statistically different from other investment categories used in the classification. Second, the portfolio could be exposed to unanticipated sources of risk. Hence, efforts to reduce risk through careful portfolio construction may be negated because of unexpectedly strong or weak performance arising from 'dimensions' of the market hidden within the crude definitions used in the portfolio construction process. Therefore, the issue of identifying the 'correct' classification of sectors and regions that best describes the property dimensions of the UK is essential in developing the most appropriate property portfolio strategies.

Based on the results above, it seems that the 3-sector scheme suggested by Eichholtz et al (1995) and Lee and Byrne (1998) is no longer appropriate. For instance, as shown in Tables 1, 2 and 3, the pure-sector variance of Retail and Offices is very small suggesting that a sector portfolio effect is present. This indicates that the 3-sector scheme is masking a number of significant within sector differences. This is confirmed in Tables 4, 5 and 6 as the majority of sectors within the Retail group show pure-sector variances that are much higher than that for the much broader classification shown in Tables 1 to 3. For instance, the unique performance of Retail Warehouses, Dept/Variety Stores and Supermarkets is shrouded within the simple Retail scheme. Similar conclusions can be made for the Industrial sector where the distinctive qualities of Industrial Parks and Distribution Warehouses are hidden away under the broad Industrial banner. Indeed, the 10-sector scheme itself may need to be enhanced as the Standard Office sector shows a very low sector effect and a relatively large regional dimension, suggesting that more refined classification of this sector may be required to extract the correct pure-sector effect for Offices.

For the regional classification, the 3-regional scheme is probably inappropriate. Moving to the 16 regions used in Table 2 provides a much clear picture of the performance of the regional portfolios. However, there seems nothing to be gained by moving to the 63-regional scheme when developing a regional classification, as the 16 regions seems to be providing much the same information at a lower computational cost. Nonetheless, Table 3 provides a number of features of interest for fund managers developing a diversified regional portfolio. First, the pure-regional variance results from Table 3 for the three areas forming Central London (The City, Mid-town and the West End) suggest that these three locations are sufficiently different from each other and from other regions of the UK that they need to be treated as "property regions" in their own right, supporting the findings of Hamelink et al (2000). Indeed, Lee and Stevenson (2001) argue that staying within London and diversifying across the various property types may offer performance comparable with diversification across the rest of the UK. Second, counties in the South and Midlands show only a small pure-regional impact and a large cumulative sector impact. In other words, staying within one sector and diversifying across these regions will offer little benefit compared with staying within a region and diversifying across the sectors. In contrast, properties in the North of England, Wales, Scotland and Northern Ireland (the peripheral regions of the UK) are largely driven by regional-specific factors, with the cumulative sector effects having little impact. Thus, diversifying across these various regions may significantly improve portfolio performance, even within a specific sector. This suggests that, a sector and regional classification scheme based on the 10 sectors and 8 regions (The City, Mid-town, West End, the Rest of Southern England and the Midlands, the North, Wales, Scotland and Northern Ireland) may not only be optimal but small enough to be practical.

Sector and Regional Diversification

The relative size of the sector and regional effects has important implications for risk reduction in a portfolio. A pure-sector portfolio assumes that the portfolio has the same regional distribution as the overall benchmark. In other words, a pure-sector portfolio is diversified across the regions. Thus, a large pure-sector variance would indicate that regional diversification is less effective than diversification within a region across the sectors. In a similar vein, a large pure-regional variance would indicate that sector diversification is less effective at risk reduction, as pure-regional portfolios are diversified by sector. The results in Tables 4, 5 and 6 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. Shown by the fact that the average variance of the pure-sector effects is larger than the pure-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. Implying, that two properties in the same sector are closer substitutes than two properties in the same region. However, as shown in Table 3, there are a number of regions for which this is not the case. For instance, the City "property region" has the largest variance of any sector or region. This implies that properties in this region are very close substitutes for each other, probably reflecting the dominance of offices in this area. In contrast, Standard Offices has the lowest variance of any sector. This implies that properties in different regions for this sector are poor substitutes, again reflecting the distinctiveness of offices in London, especially the City, from the rest of the UK.

Tracking Error Risk

Fund managers are not only concerned with the overall risk of their portfolios. They are equally, or more, interested in the risk of their portfolio returns relative to some benchmark of performance (Roll, 1992). Fund mangers therefore need to be aware of the impact on tracking error fom rearranging the composition of the portfolio as a result of sector and regional tilts. The "pure" factor approach that we have used has important implications for portfolio management with regard to this aspect. The active portfolio manager will have to decide according to which factor he/she wants to make a bet. If a sector with positive expected returns and low cross-regional correlation coefficients is selected, for instance, he/she has to make sure that this strategy is neutral with respect to the regional dimension. Alternatively, it could be decided that an investment in a particular region is desirable. If the "pure" factor approach is not used, such strategies will almost certainly involve making implicit sector bets simultaneously. With the "pure" approach, the effects of such strategies on the exposure to "pure" sector factors as compared to that of the benchmark can be minimized.

Implementing such a strategy, however, depends on whether a sector bet also implies a regional bet. The average cross-correlation between "pure" sector and regional factors are all close to zero for the 10-by-16 and 10-by-63 classification schemes (0.042 and 0.024 respectively). This indicates that if an active portfolio manager makes a bet according to one of the two factors, this does not imply that he is making simultaneously a bet on the other factor. For instance, if one believes that a sector will perform well in the future and a decision is made to overweight this sector, this does not imply that this decision will have an impact in terms of the exposure to a region. This discussion is of course based on "pure" factors. In reality, it is not possible to gain exposure to the "pure" factors, but rather when a decision is made for instance to overweight one sector, then this will not have in most cases a neutral effect on the regional effect. To overcome this difficulty, constrained optimization techniques may be used to construct a model portfolio that takes active bets on specific "pure" factors, while keeping the exposures to other factor neutral.

As shown in Tables 4 to 6, since the pure-sector variances are on average greater than the pure-regional variance, the tracking errors induced by tilting a portfolio away from the sector composition of the benchmark portfolio will be greater than those from regional tilts. For instance, suppose a UK real estate fund manager is considering a sector bet by increasing his weight into Standard Industrials, or a regional bet as a result of a tilt towards the West Midlands. The results from Table 5 indicate that replacing 10% of the properties in an equal-weighted UK property portfolio with properties from the West Midlands would have resulted a slight under-performance of -0.02% per annum, with a tracking error variance of only 0.501-squared. In comparison, a 10% tilt by the fund manager into Standard 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 2.57-squared. This is a tracking error variance almost five times greater than that for the West Midlands regional tilt. However, as shown in Table 3, a number of regions show pure-regional specific effects greater than that for the sectors. For instance, the inner London property regions of the City, Mid-town and West End have variances higher than any sector. Thus, a fund manger considering a regional bet in these areas needs to be extremely careful as the wrong decision here has the greatest impact of all sectors and regions on tracking error risk.

9. Conclusions

The benefits of sector and regional diversification have been well documented in the real estate literature. However, previous studies have used only a small number of sector and regional classification schemes. We have re-examined this issue by using the largest commercial property database currently available in the world, the IPD annual database, containing up to 12,767 properties in any one year. Such a large database allows a number of more detailed classifications of sectors and regions to be constructed than the simple 3-by-3 scheme suggested in previous studies. In this way we can test the impact that finer classifications have on the sector and regional effects. We use constrained cross-section regressions to disentangle a common factor and "pure" sector and regional effects. It is found that the sector-specific effect still has a greater influence on property returns than regional factors. Second, the impact of the sector effect is generally robust across different specifications of sectors and regions. Third, the dominance of the sector effects over the regional effects varies considerably over the property cycle. Finally, the more refined sector and regional partitions uncover some interesting sector and regional differences that were obscured in previous studies.

An important practical implication of the method used in this paper is that investors can see the affect on tracking error of their decisions according to what factors he/she wants to make bets. For instance, a bet can be made to overweight certain sectors that are expected to have with higher returns and low cross-sector correlation coefficients, without simultaneously making a regional bet. For that purpose, an optimizer can be used to gain exposure to the selected segments, while at the same time minimizing the difference between the exposure of the portfolio to other factors and the exposure of the benchmark to these factors.

Further areas of research will examine the results over time in more detail, consider the impact of classifying the data into economic regions, and consider whether additional property specific factors such as size, depreciation, rental growth and yield affect the conclusions.

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