The Cyclical Behaviour of Sector and Regional Diversification Benefits: 1987-2002

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Abstract

This paper investigates the time series behaviour of the relative benefits of sector and regional diversification strategies, using the notion of cross-sectional dispersion introduced by Solnik and Roulet (2000). Using monthly data over the period 1987:1 to 2002:12, four sector and four regional classifications are examined in the UK. The results indicate that sector and regional dispersion indices are highly time varying and so dwarf any lower frequency cyclical components that may be present. Nonetheless, periods of high dispersion are closely followed by periods of low dispersion, suggestive of cyclical behaviour of sector and regional diversification benefits. Then, using the HP-filter we isolated the cyclical component of the various dispersion indices and found that the sector dispersion indices are generally above the regional dispersion indices. This implies that a sector diversification strategy is likely to offer greater risk reduction benefits than a regional diversification approach. Nonetheless, we find that in some periods, certain regional diversification strategies are of equal or greater benefit than certain sector approaches. The results also appear to be quite sensitive to the classifications of sectors and regions. Hence, the appropriate definition of sectors and regions can have important implications for sector and regional diversification strategies.

Keywords: *Sector and Regional Diversification, Dispersion Indices, HP-filter*

The Cyclical Behaviour of Sector and Regional Diversification Benefits: 1987-2002

Introduction

The relative benefit of sector and regional diversification is a topic of continuing interest to academics. Using a variety of statistical techniques, the consensus has been that sector (property-type) diversification is preferable to regional (geographical) diversification in terms of risk reduction (see Viezer, 2000 and Hamelink et al, 2000 for comprehensive reviews). The simplest way to examine this issue is to calculate the correlation across sectors and regions and test whether the average sector coefficients are significantly lower than the average regional coefficients, as the lower the average correlation, the greater the diversification benefits. However, in a recent paper, Andrew et al (2003) note that there appears to be a variation in the relative benefits of sector and region diversification suggestive of cyclical behaviour. The calculation of a single correlation matrix or an approach based on two adjacent samples does not provide any insight into the cyclical nature of one diversification strategy compared with another. While, a test based on rolling correlation coefficients would make little sense, since virtually no change would be observed based on conventional testing procedures, owing to overlapping data. Hence, traditional correlation analysis is inappropriate for testing the cyclical nature of sector and regional diversification strategies.

An alternative approach is to use the dummy variable methodology of Heston and Rouwenhorst (HR) (1994). The HR approach assumes that the generating process affecting the returns of individual properties can be represented by several (orthogonally defined) factors, in this case the property's sector and regional affiliation as in equation 1:

$$R_i = \alpha + \beta_j F_j + \gamma_k F_k + \varepsilon_i \qquad (1)$$

where the HR model assumes that the return on each property depends on four components: a national factor (α) representing the performance of the property market in general, sector factors (β) and regional factors (γ) and a property-specific disturbance (ε). Using this approach the findings of a number of studies show almost unanimously that the sector factors dominate the regional specific effects (see Andrew et al, 2003 for a review). Nonetheless, the HR methodology presents a number of potential difficulties especially if the relative importance of the sector and regional effects is time varying.

First, while the dummy-variable model presents an elegantly simple way to separate regional and sector effects, it rules out any interaction between these effects. That is the model assumes that the returns of a property are determined by a specific sector and region and that it cannot be sensitive to other sectors or regions. This sector and regional factor orthogonalisation implies that the first step of an optimal asset allocation should be done at the level of the sector or regional indices. So if one believes that a sector will perform well in the future and a decision is made to overweight this sector, the orthogonalisation implies that this decision will have no impact in terms of the funds exposure to a region. However, if the assumption of

factor orthogonality does not hold, then when a decision is made to overweight a sector this will also have a regional impact. Hence, the first step in the asset allocation process will depend on the sensitivities of the individual properties to the different sector and regional factors.

A second problem associated with the HR approach is that it assumes that all properties from the same sector/region have the same sensitivity to the sector- and regional-specific factors. A recent paper by Brooks and Del Negro (2002) takes issue with this assumption and goes on to test this hypothesis in the international equity market. The authors find that the supposition that the coefficients of equities to their own country factors are all unity can be unequivocally rejected. Thus, the decomposition of the equity data into country-specific effects maybe compromised.

Finally, in order to evaluate the importance of sector and regional effects using the HR approach, the coefficients of the sector and regional factors are first estimated with property data on a cross-sectional basis. Then the relative influence of both factors is determined by comparing either the relative variances of the coefficients or the mean average deviations (MAD) of the sector and regional-specific effects. 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. In a similar vein, if the MAD 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. However, any cyclical behaviour in the sector and regional factors will be lost if only the overall results are presented. To overcome this, Lee and Devaney (2003) tested the relative benefit of sector and regional diversification using a rolling 24-month MAD calculation over the period 1987:1 to 2002:12. The authors classified the UK property market into 3 sectors; Retail, Office, and Industrial and 3 super-geographical regions; London, the Rest of the Southeast and the Rest of the UK. Lee and Devaney (2003) conclude that sector effects are greater than regional factors overall, but that there are periods when the regional effects are as great as the sector factors. In other words, the relative sector and regional diversification strategies are time-varying.

The results of Andrew et al (2003) however suggest that the 3-by-3 sector/regional scheme used by Lee and Devaney (2003) may be inappropriate for today's real estate market. Due to the fragmentation of the traditional property sectors into further distinct property types, such as Retail Warehouses, along with the growing differentiation of regional economic growth across the UK. Furthermore, Andrew et al (2003) find that certain areas in London may need to be treated as distinct property areas in their own right and so need to be included in any study of sector and regional diversification strategies.

It seems prudent therefore to re-examine the relative benefits of sector and regional diversification with an alternative methodology and a number of different data sets. Consequently, we take a different approach that is consistent with an unrestricted model, which simply states that a property can be subjected to multiple sources of uncertainty. We then apply the methodology to a number of different sector and regional categorisations in order to examine whether the dominance of the sector effect in the 3-by-3 classification is robust to more refined categorisations. In order to

do this we use the notion of cross-sectional dispersion first introduced by Solnik and Roulet (2000)[1] to measure diversification potential across both sectors and regions. This methodology is then applied to three sector classifications and five regional categorisations.

The remainder of the paper is structured as follows. The next section gives details of the dispersion methodology of Solnik and Roulet (2000). Section three discusses the data used. The next section presents the results of the dispersion calculations. Section five then investigates the cyclical behaviour of sector and regional diversification benefits. The final section presents the conclusions.

Methodology

The idea behind the cross-sectional dispersion approach of Solnik and Roulet (2000) is very intuitive and works as follows. Consider *n* financial assets over a particular investment period; the more dispersed their returns turn out to be, the more scope there is for portfolio diversification. If on the other hand, the dispersion of returns is small, the more similar these asset returns are and the less room there is for diversification. Given that this dispersion is defined in terms of the *n* assets existing at time t, a time series of the cross-sectional dispersion of returns can be generated and its properties can be examined in the standard time series framework. In particular, in the case of sector indices with monthly observations, a standard deviation across the *n* sector index returns can be calculated each month. Similarly, the regional returns can be used each month to generate a regional cross-sectional dispersion index.

As discussed by Solnik and Roulet (2000), there is a direct and inverse relation between dispersion and diversification benefits. Higher return dispersion implies lower correlation and so greater diversification benefits. In contrast, lower dispersion implies higher correlation across the assets and so limited diversification benefits. In other words, if the cross-sectional standard deviation of sectors is greater than the cross-sectional dispersion of regions then sector diversification offers greater benefits than regional diversification and visa-versa. However, these benefits may change over time as the property cycle moves from boom to bust. An examination of the time-series performance of these cross-sectional sector and regional dispersion indices, therefore, will reveal any cyclical behaviour.

The cross-sectional dispersion methodology of Solnik and Roulet (2000) is particularly useful for testing the relative benefits of sector and regional diversification for at least two reasons. First, dispersion indicators can be generated from the available frequency of the returns even with a short time-series, as it involves no averaging of the data. Second, it provides an instantaneous comparison and thus allows for a more thorough investigation of the evolution of the sector and

[1] Hess and Liang (2000) have used a similar approach to measure changes in regional market selection in the investment process in the US real estate market. The authors arguing that when the regional dispersion index is high it indicates that portfolio managers have greater opportunity to select investments that display superior performance than they do when regional dispersion is low, although the potential for selecting inferior regions also increases with increases in the dispersion index. In other words, the regional dispersion index indicates the importance of regional selection strategies in the investment process.

regional diversification opportunities over time. This is especially so if the volatile dispersion indices are filtered to extract the slowly moving cyclical components.

Data

The data used in this study are monthly total returns from the Investment Property Databank (IPD) UK monthly database. The IPD monthly indices are based on the individual property data from 53 institutional investors and cover more than 2,500 properties valued at £11.6 billion at the end of 2002 (IPD, 2003).

These indices represent all standing investments in any month in the IPD monthly database. Standing investments are properties that are held in portfolios and not bought or sold, or subject to development or significant improvement expenditure during the period. Properties that did not belong to one of the three main sectors (Retail, Office and Industrial) were excluded from the analysis. These are typically investments in such sectors as agricultural land and leisure, which do not form a significant part of most institutional portfolios in the UK. Various sector and regional indices were calculated from the individual property data on both an equal- and value-weighted basis[2].

Table 1: Summary of Sector and Regional Classifications

Classification	Constituents
3-sectors	Retail, Office and Industrial
5-sectors: Industrial	Retail, Office Standard Industrial, Industrial Distribution Centres, and Industrial/Office-Mixed
5-sectors: Retail	Standard Retail, Office, Industrial, Retail Warehouse and Shopping Centres
7-sectors	Standard Retail, Office, Standard Industrial, Retail Warehouse and Shopping Centres, Industrial Distribution Centres, and Industrial/Office-Mixed
3-regions	London, Rest of SE and Rest of UK
7-regions	London, Inner SE, Outer SE, South West, Eastern, Midlands & Wales and North & Scotland
8-regions	Central London, Rest of London, Inner SE, Outer SE, South West, Eastern, Midlands & Wales and North & Scotland
9-regions	City, Midtown/WE, Rest of London, Inner and Outer SE, South West, Eastern, Midlands & Wales and North & Scotland

Given the discussions above, it seems appropriate to use a number of different data sets. The first is the 3-by-3 categorisation used by Lee and Devaney (2003). However, given the findings of Andrew et al (2003) that the 3-by-3 categorisations of the UK may be no longer appropriate, we expand the number of sectors used from three to five and then to seven. The first approach is to breakdown the Industrial sector into three categories: Standard Industrial, Industrial Distribution Centres and mixed Industrial/Office properties. The next refinement is to break the Retail sector into: Standard Retail, Retail Warehouses and Shopping Centres. These last two property-types having been identified by Andrew et al (2003) as distinct sectors in their own right reason. The robustness of this conclusion can therefore be examined with a different data set. Finally, we construct a sector scheme that combines the refinements of both the Retail and Industrial sectors. This gives four possible classifications of the sectors, the constituents of which are summarised in Table 1.

[2] The results of the equal- and value-weighted indices are qualitatively the same and so to save space only the value-weighted results are presented. The equal-weighted results are available upon request.

The 3-region classification used by Lee and Devaney (2003) was also expanded in stages up to a 9-regional scheme. This use of a number of regional categorisations was done to try and shed light on the importance of correctly defining regions for portfolio diversification purposes. First, the two super-regions outside London were broken into the Inner Southeast, Outer Southeast, Eastern, Southwest, Midlands & Wales and the North & Scotland. This was done as the peripheral regions of the UK have been shown to display additional diversification advantages over investment in London (see Eichhotlz et al, 1995 and Lee and Byrne, 1998). Finally, Andrew et al (2003) suggest that certain areas within London can be considered distinct property markets in their own right and so need to be included in any study of sector and regional diversification strategies. Furthermore, Lee and Stevenson (2001) argue that diversifying across property in London may offer performance comparable with diversification across the rest of the UK. Hence, the London region was first broken down into two broad regions: Central London and the Rest of London. Central London was then subsequently broken down in two "property markets" the City and Midtown/West End. Thus we have four possible classifications of the regions, the constituents of which are shown in Table 1.

Dispersion Indices

The results of the cross-sectional sector and regional dispersion calculations are presented in Table 2. Panel A of Table 2 shows the mean and standard deviation of the various sector and regional dispersion indices. Panel B of Table 2 presents the *p*-values of the tests of the equality of means based on the results of a series of t-tests.

Table 2: Summary Statistics of Sector and Regional Dispersion Indices

Sector/region	Sectors				Regions			
Panel A Statistics	**3**	**5 Ind.**	**5 Ret.**	**7**	**3**	**7**	**8**	**9**
Mean	**0.351**	**0.407**	**0.498**	**0.506**	**0.261**	**0.320**	**0.369**	**0.474**
SD	**0.291**	**0.272**	**0.308**	**0.304**	**0.201**	**0.207**	**0.248**	**0.378**
Panel B p-values	**3**	**5 Ind..**	**5 Ret.**	**7**	**3**	**7**	**8**	**9**
3-sectors	**N/a**							
5-sectors: Industrial	**0.000**	**N/a**						
5-sectors: Retail	**0.050**	**0.002**	**N/a**					
7-sectors	**0.000**	**0.000**	**0.787**	**N/a**				
3-regions	**0.000**	**0.000**	**0.000**	**0.000**	**N/a**			
7-regions	**0.231**	**0.000**	**0.001**	**0.000**	**0.005**	**N/a**		
8-regions	**0.513**	**0.000**	**0.150**	**0.000**	**0.000**	**0.036**	**N/a**	
9-regions	**0.000**	**0.499**	**0.048**	**0.357**	**0.000**	**0.000**	**0.001**	**N/a**

Table 2 presents a number of features of interest. First, the mean of the 7-sector dispersion indices is significantly greater than all the regional categorisations, except for the 9-regional classification scheme. This suggests that diversification across these sectors is likely to dominate any regional diversification approach.

Second, the mean of the 7-sector dispersion index is significantly greater than the 3-sector scheme and the 5-sector (Industrial) scheme. However, the 7-sector dispersion index is insignificantly greater than the 5-sector (Retail) scheme. This suggests that it is that breaking Retail down into more refined categories that offers significant improvements in risk-reduction. Thus, retail warehouses and shopping centres probably need to be treated as distinct real estate investments markets in their own

right. As such the 3-sector scheme is in all probability no longer appropriate to use for property-type diversification strategies in the UK, confirming the findings of Andrew et al (2003). Nonetheless, the 3-sector scheme has an average value significantly greater than most of regional classification schemes, suggesting that even the 3-sector scheme is likely to offer better diversification benefits than most of the regional approaches.

However, differentiating industrials seems to offer little in the way of increased diversification benefits over a 3-sector strategy. This would seem to suggest that industrial property in the UK can be treated as a single market for diversification purposes. This supports the findings of Cullen (1993) who found that industrial properties are relatively homogeneous across the UK. However, the result is in contrast to those of Andrew et al (2003) who found significant difference between the various industrial property-types. This difference in result may be as a consequence of the use of monthly as opposed to annual data, as the monthly data is based on the performance of much smaller real estate funds who maybe unable to purchase the larger and more discernibly different industrial properties such as Industrial Distribution Centres.

Third, the mean of the 9-region scheme is significantly greater than all the other regional schemes. This implies that the use of a more refined classification of the UK property market can have important implications for regional diversification strategies. In particular, the results show that the classification of Central London into certain property markets significantly increases the regional dispersion index over that in which London is treated as a region as a whole. This demonstrates that the City and Midtown/West End markets need to be considered as real estate investment markets in their own right. In addition, this suggests that investment across the property markets within London should offer substantial diversification opportunities, as found by Lee and Stevenson (2001). Nonetheless, the mean of the 3-sector classification is significantly greater than most regional schemes. Thus, a simple three-way classification of the regions in the UK may provide a reasonable diversification strategy for all but the largest investors who can access the Central London market.

Finally, the standard deviations in Table 2 show that there is a good deal of variability in the dispersion indices over the sample period. This is shown graphically in Figures 1 and 2, which plot the raw dispersion indices for the four sector and four regional classification schemes respectively.

An examination of both Figures 1 and 2 shows that both time series are highly time varying and so hide any lower frequency cyclical components that may be present. Nonetheless, periods of high dispersion are closely followed by periods of low dispersion, suggestive of a cycle in the time series behaviour of sector and regional diversification benefits. Figure 1 also shows that the 7-sector categorisation is generally above the other sector classifications. This implies that the more refined sector schemes should offer greater diversification benefits than the simplest schemes. A similar conclusion can be made for the 9-regional scheme in Figure 2. Finally, when we compare the values in Figure 1 with those in Figure 2 it is easy to see that

the sector dispersion data is general above that of the regional data, which implies sector diversification should dominate a regional diversification approach.

The Cyclical Behaviour of Sector and Regional Diversification

The results above suggest that a sector strategy should offer greater diversification benefits than a regional approach for the majority of the time. This is investigated by examining the variation of the sector and regional dispersion indices over time. The variation in the behaviour of the dispersion indices is more easily seen if one filters the sector and regional series to extract the slowly moving cyclical components. This requires that the various measures of dispersion be appropriately detrended to exact the relevant cyclical components from the raw data. The approach used in this study is the Hodrick and Prescott (HP) (1980) methodology, which is the most commonly, used detrending method in applied econometric work. The HP-filter was initially developed in order to investigate the business cycle. However, Brookes et al (2000), McGough and Tsolacos (1997) and Witkiewicz (2002) among others have successively applied the methodology to the real estate market.

As noted by Kydland and Prescott (1990), the HP-filter has at least two attractive features. First, the HP-filter can accommodate time-series with changing mean growth rates. Second, the HP-filter is particularly well suited to comparisons across many variables as the linear trend fitted to each of the original time-series is identical for all series considered[3]. The result of applying the HP-filter to all the sector and regional dispersion indices is presented in Figure 3.

Figure 3 reveals a number of features of interest. First, the cross-sectional dispersions were above average, both at the sector and the regional level, in the first half of the time-series, with the dispersion indices reaching a peak in the late 1980s in parallel with the peak of the property market. The sector and regional dispersion indices have been generally much lower ever since, even in the minor booms of 1997 and 2000.

Second, Figure 3 shows that the HP-filtered dispersion indices tend to rise and fall in line with the market booms and busts. This observable cyclical behaviour in the dispersion indices indicates a strong cycle in the relative benefits in sector and regional diversification, supporting the findings of Andrew et al (2003) and Lee and Devaney (2003). That is during periods of growth in the real estate market, all properties rise but at differing rates, and so the average correlation across assets declines leading to greater diversification opportunities. However, when the market declines, asset returns have a tendency to converge, leading to higher correlation across the individual properties, and so lower diversification benefits - exactly when diversification is need. This corroborates the observations of Morrell (1997) who documents an increase in dispersion in the performance of UK property segments in the market boom and a decline in dispersion in the market collapse.

Third, Figure 3 shows that the 5-sector (Retail) and 7-sector categorisations dominate the 3-sector and 5-sector (Industrial) classification schemes, confirming the results in Table 2. Nonetheless, the difference between the various dispersion indices appears

[3] See Nelson and Plosser (1982) for a more detailed discussion of the HP-filter, as well as alternative procedures.

to have decreased in the latter part of our sample. The 7- and 5-sector (Retail) schemes also dominate all the regional classifications, except for the 9-regional scheme in the first half of the sample period. Thus, a sector diversification strategy is likely to eclipse any regional approach.

However, when we examine the 5-sector (Industrial) strategy further we find that such an approach is dominated by the 8- and 9- regional HP filtered dispersion indices and, in a number of periods, by the 3-sector scheme. This supports the results above that such a sector classification scheme offers little above that of the 3-sector scheme.

In addition, Figure 3 shows that from the start of 1993 until the end of 1998 the 3-regional dispersion index is higher than the 3-sector index. This implies that in many periods a simple regional diversification strategy may be preferred to a simple sector diversification approach. This supports the results of Lee and Devaney (2003) who used the HR methodology on this same data set.

Finally, although in general the greater the disaggregation of the regions the greater the dispersion, moving from a 3-region scheme to a 7-region scheme leads to hardly any improvement in diversification prospects. Nonetheless, Figure 3 clearly shows that the disaggregation of London into a number of "property markets", under the 9-regions scheme, clearly leads to greater dispersion and so larger diversification benefits. In other words, certain areas in London need to be treated as distinct property markets for diversification purposes.

Conclusions

This study has investigated the time series behaviour of the relative benefits of sector and regional diversification strategies using the notion of cross-sectional dispersion introduced by Solnik and Roulet (2000). Using monthly data over the period 1987:1 to 2002:12, four sector and four regional classifications are examined in the UK. The results indicate that sector and regional dispersion indices are highly time varying and so dwarf any lower frequency cyclical components that may be present. Nonetheless, periods of high dispersion are closely followed by periods of low dispersion, suggestive of cyclical behaviour of sector and regional diversification benefits.

Then, using the HP-filter we isolated the cyclical component of the various dispersion indices and found that the sector dispersion indices are generally above the regional dispersion indices, which implies that a sector diversification strategy is likely to offer greater risk reduction benefits than a regional diversification approach. Nonetheless, we find that in some periods certain regional diversification strategies are of equal or greater benefit than certain sector approaches. In addition, while some classifications of the sectors and regions offered improvements in diversification potential others offered little benefit. Thus, the results appear to be quite sensitive to the classifications of sectors and regions. Hence, the appropriate definition of sectors and regions can have important implications for sector and regional diversification strategies.

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Figure 1: Sector Dispersion Indices: Monthly Data 1987:1 - 2002:12

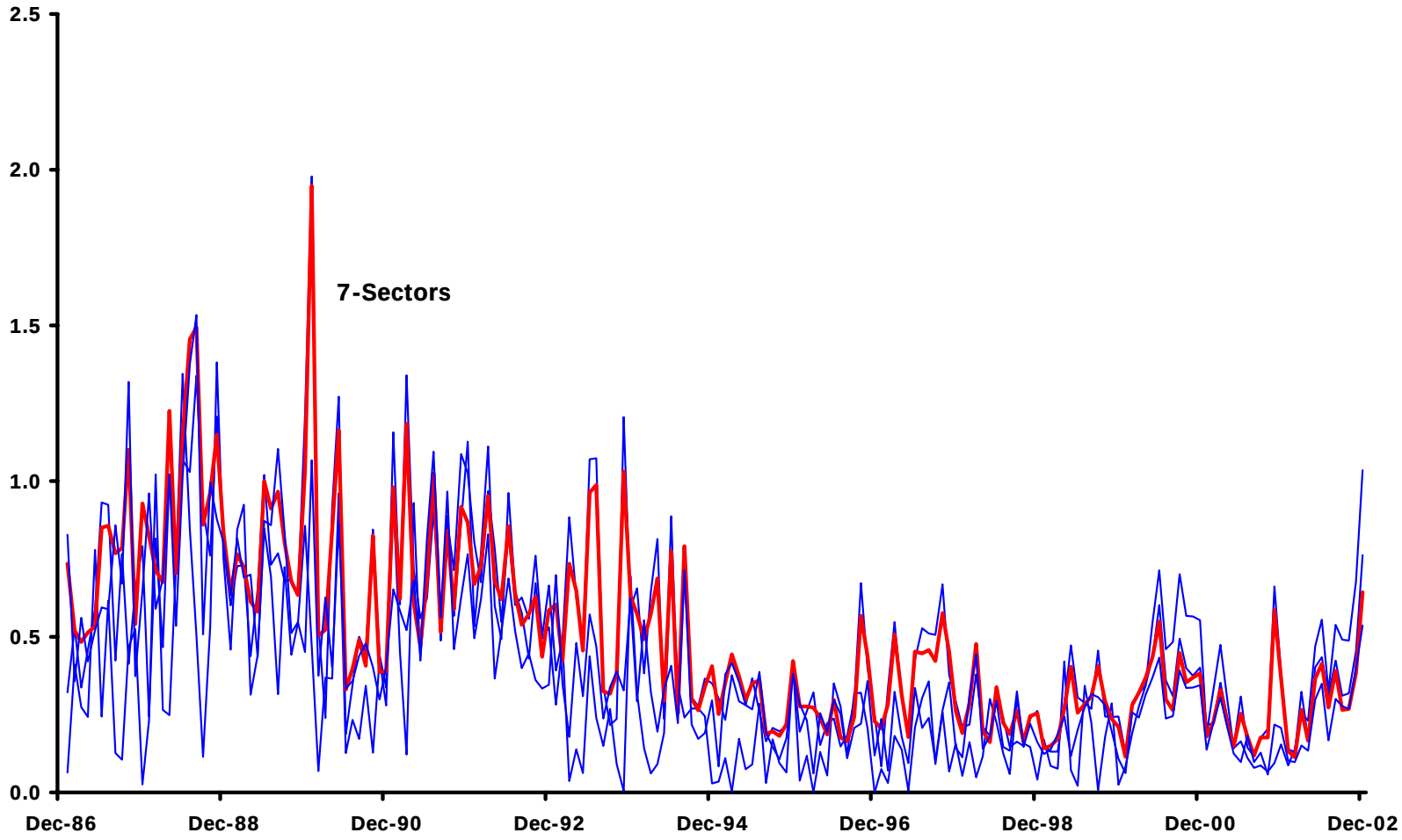

Figure 2: Four Regional Dispersion Indices: Monthly Data 1987:1 - 2002:12

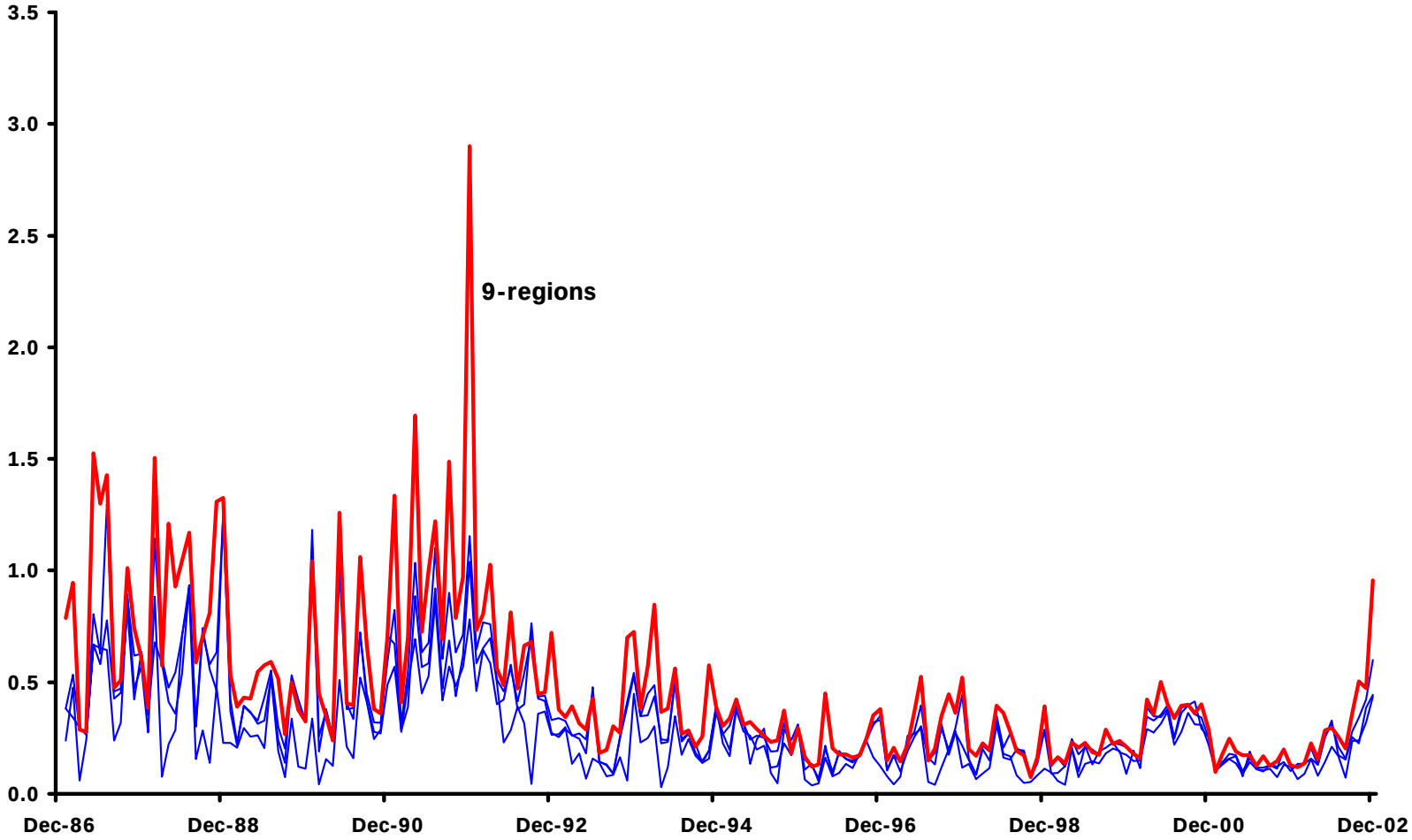

Figure 3: HP-Filtered Dispersion Indices: Four Sector and Four Regional Classification Schemes