IPF Research Programme 2006-2009

RISK WEB 2.0
An Investigation into the Causes of Portfolio Risk

Final Report

March 2011

This research was commissioned by the
IPF Research Programme 2006–2009

IPF Investment Property Forum

The IPF Research Programme has developed as an important provider of high quality independent research focused specifically on property investment. We can only continue to fulfil this role due to the support of our 24 research sponsors. We are very grateful to this group of companies for their support of the programme.

Addleshaw Goddard
Aviva Investors
British Land
Credit Suisse
Deloitte.
DLA Piper
DTZ
GIC Real Estate
Grosvenor
GVA
Hammerson
Helical Bar plc
IPD
Kenmore property group
Knight Frank
LandSecurities
LaSalle Investment Management
Legal & General
Nabarro Clarity Matters
PRUPIM
Quintain
Standard Life Investments
Strutt & Parker
Scottish Widows Investment Partnership

RISK WEB 2.0
AN INVESTIGATION INTO THE CAUSES OF PORTFOLIO RISK

Final Report

IPF Research Programme 2006–2009

March 2011

Research team

Gerald Blundell

Malcom Frodsham, *IPD*

Roberto Martinez Diaz, *IPD*

Research steering group

Disclaimer

CONTENTS

CONTENTS

1. INTRODUCTION

Concern about risk should be an ever present issue with investment managers because the risk of poorer performance is the price they pay to achieve returns in excess of the risk free rate. It is somewhat ironic then that concern about risk tends to rise after asset prices have fallen. Failure to perceive risk in rising markets may be due to its changing nature, each cycle being characterised by its own sources of risk. Most recently leverage was the dominant factor; at the beginning of the decade it was tenant failure, whilst in the late 1980s the oversupply of space.

Property market risk then comes in many forms. A questionnaire in 2000 conducted by the IPF and IPD recorded 57 varieties from property industry respondents. More generally, risk can be split between market risk, risk specific to assets and collections of assets. Since the 2000 questionnaire, the perceived sources of risk have widened. The experience of the past couple of years has demonstrated that risk can also be imported from the wider capital markets via the conduit of leverage. This study is concerned with identifying risk factors that are consistently linked with the subsequent relative performance of portfolios through varying market conditions. These factors will have varying degrees of importance from year to year and some factors will be particularly associated with downside risk rather than upside variance.

Conventionally, risk in property portfolios has been estimated in terms of its past performance. But through the life of a portfolio property assets come and go. So the historic chain of fund and returns cannot be used to estimate future fund volatility as it largely relates to the behavior of assets no longer in the portfolio. Similarly it is an error to equate future asset risk with that asset's past performance; an asset's characteristics change through time due to functional obsolescence, physical deterioration, locational dynamics and so on.

It would, therefore, be highly advantageous if portfolio risk measures were available that looked forward to likely future risk, so as to inform current investment decisions in a timely manner, and that is the purpose of this study. Such factors are, of course, also the sources of return and so they can be used to define portfolio strategies and style.

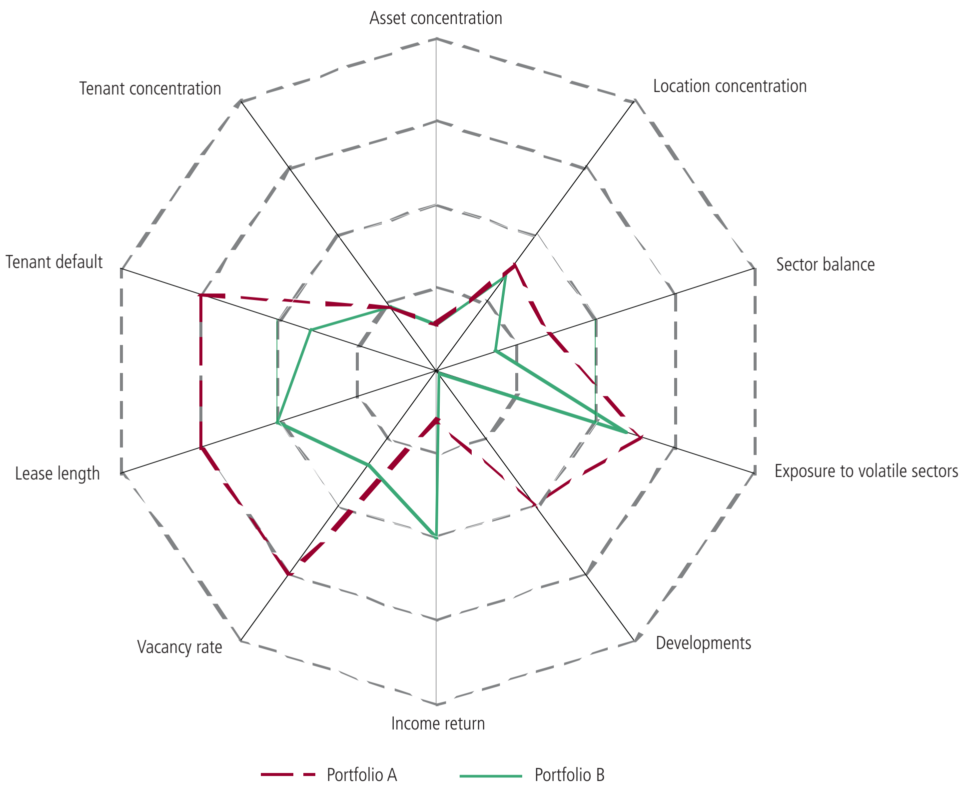
Over the course of the past decade property managers have begun to extend their focus to look at the factors in portfolios that they associate with future risk. In 2003 Blundell, Fairchild and Goodchild presented a paper to the IPD/IPF Conference of that year (subsequently published in the *Journal of Property Research* vol 22 June/Sept 2005) showing analyses of the linkages between portfolio risk factors and subsequent relative returns; some reasonably significant relationships were found.

The authors argued that, since risk was believed to be generated by a range of factors, it made sense to depict a portfolio's risk in terms of those factors. Figure 1 shows the method they developed, which has subsequently been applied in various forms by a number of UK portfolio managers. In the Figure, Portfolio A is shown with a red dotted line. It is scored on 10 factors to develop a visual profile over the spokes of the web. The bigger the profile the greater the prospective risk in the portfolio. Portfolio A has considerable relative risk in tenant covenant and lease length, but this is compensated by low risk scores elsewhere. If the highest risk covenants stay solvent and leases can be renewed then fund returns will be relatively high, compensating for the risk taken.

Portfolio A has a bias, or style tilt, relative to its benchmark toward income risk and away from growth (low income return) and larger individual assets. The risk web can be used to check on the alignment between the balance of risks in the portfolio and its stated investment style and objectives. Managers can evaluate the impact of planned purchases and sales and management activity on their risk profile.

1. INTRODUCTION

Figure 1: Risk Web 1.0, 2003 model



While the component spokes of the Risk Web 1.0 had been underpinned by some statistical analysis, the data on which some of the work was based, especially relating to tenants, was limited to less than 10 years so only conjectural conclusions could be drawn. Moreover, risk was measured only in the terms of the factors used in the risk web, not expressed in units related to returns; the absence of a common unit of account prevented an overall risk score being produced.

Over the past six years we have seen the addition of significantly more portfolio data, which allows further testing of the significance of these factors across a wide range of market conditions, especially over the last couple of years. In addition, the rise in unlisted funds has now added further risk factors to consider: leverage and exposure to unlisted vehicles.

It was to address these issues that the Investment Property Forum decided to fund research into a second generation risk web, Risk Web 2.0, re-visiting the original 2003 work with the benefit of six years' extra data.

The objectives of this study are three-fold. First, it aims to update the 2003 Risk Web analysis now that a longer and more extensive time series is available, with a view to developing a better understanding of what causes portfolio risk and how these causes vary though the cycle.

Second, the study will attempt to develop quantitative models of portfolio risk, that is, risk expressed in terms of subsequent differences between portfolio return and the market average. It should be noted that this is not a forecast of market risk per se; it is an attempt to predict how a portfolio will behave relative to the market's ups and downs. This is, arguably, a somewhat harder task than merely predicting the direction of the market because portfolio managers will have diversified away a proportion of risk as they have built their portfolios, leaving only that consistent with the style and objectives of the fund. In this study, portfolio risk is defined as this residual difference in performance between the fund and the market; the greater the difference, the greater the risk.

Third, with so many potential sources of risk (the study looked at 43), any predictive model is likely to vary its components through time; the study aims to identify the evergreen risk factors that are usually present over the years as well as those factors that are significant only in certain market conditions: the risk of flooding may only be present in the monsoon season but the risk of fire is ever present.

The study then goes on to use these findings to illustrate several ways in which an overall risk score could be computed, thereby enhancing the original risk web concept, which did not provide an overall portfolio score.

The idea of an overall score is, however, not without its dangers. While popular, it could well distract from the factors that cause the risk; one of the key benefits of the risk web approach is the focus on the mix of risks constituting the portfolio, not least because this throws light on its likely investment style. However, a widely recognised and effective fund risk score would increase market transparency, enabling investors to choose the funds most suited to their appetite for the different types of risk attached to property. Investors can also compute their own risk score, weighting the risk factors according to their own appetite for certain aspects of risk. Similarly, it would allow fund management houses to design and label their suite of fund products appropriately in their marketing material to investors.

It is hoped that the findings of this study will be of direct interest to investors concerned about potential tracking error. This measure of portfolio risk is of interest to investors and managers whose investment objectives are framed with regard to the performance of the market as a whole, for example tracking funds, or managers with a mandate to deliver returns within a specified range. To date, analysis of tracking error has been limited to analyses of past variance. This study represents an attempt to provide managers with a forward looking view and to allow them to assess the balance of risks embedded in a portfolio. In addition to the usual testing of the impact on return, this also enables their portfolios to be tested for the effect of additions and subtractions through asset transactions.

The body of this report is divided into four main parts. Section 2, following, deals with the approach to the analysis, the data used and the scope though time. Sections 3 to 5 report results and the main conclusions that can be drawn. Section 6 develops a scorecard system for assessing the risk latent in portfolios that can be inferred from their characteristics. Conclusions and suggestions for further research are set out in section 7.

2. APPROACH

The essence of the approach was to catalogue a set of factors across a sample of portfolios at the end of each year from 1998 to 2008. These factors were then related to the relative performance of the portfolio in the following one, two and three years. Naturally, the success of this approach hinged on the factors selected.

To maximize the chances of selecting predictive factors, an initial set was discussed with a special meeting of IPF sponsors at the start of the study. Then, after initial statistical analysis, the results were reviewed by the study's Steering Group. Both these exercises resulted in a number of useful suggestions and additions to the initial set of factors. In all 43 portfolio risk factors were evaluated.

2.1 The data

All the data for the study was sourced from the Investment Property Databank (IPD), which was also responsible for the statistical analyses.

Data relating to over 250 portfolios were available from 1998 to 2008 (risk factors) and 1999 to 2009 (returns). This period was selected as it covered the most recent years and contained a consistent set of data. Prior to 1998 a number of factors either did not exist or were not collected on a comparable basis. Additionally, six factors relating to covenant strength and leverage were not available before 2001.

But to what extent can 1999 to 2009 be regarded as typical? Of course, each decade has its own unique features, and the last 10 years are no exception, containing the most severe financial crisis and recession since the 1930s. Taken as a whole, average total returns were 7.8% pa, low compared with the longer term 1970 to 2009 average of 10.8% pa. This lower figure was due to lower capital returns, but it is worth noting that inflation (RPI measure), at 2.6% pa, was also low relative to its long term trend of 4% pa.

However, what makes the period particularly interesting to analyse is the range of market conditions that it contains. The -22.1% total return of 2008 is the lowest on record, as measured by IPD in the UK, and the 19.1% of 2005 was the ninth highest. Such a wide range of conditions provides a very good stress test of any findings thrown up by the study.

Prior to analysing the data, it was cleaned by removing material relating to properties valued at less than £10,000. Also, in each year there were one or two portfolios whose returns were so different to the rest as to distort the results if they were left in. These were deleted without significantly impacting sample size, in the interest of getting results more representative of the bulk of the sample.

2.2 What is meant by risk?

As has been said, the property industry defines and measures risk in a number of ways. Risk is frequently linked with measures derived from return volatility, which should be calculated from long time series of returns, at least 10 periods in length. This approach is not adopted in this study since to do so would mean linking portfolio characteristics with subsequent performance stretching over many years. The objection here is that, over time, the portfolio does not stand still. Accordingly, the factors increasingly do not relate to the portfolio characteristics delivering the subsequent performance; they relate more to the manager's style of behaviour, if there is one.

Instead, the factors describing the sample of portfolios at December of any one year are compared with the relative performance of their portfolios in the following year; essentially, a cross sectional analysis rather than one using time series. Because only one, two or three years' forward performance are being analysed, the usual measures of risk cannot be used. Instead, it is argued that risky portfolios are those whose performance diverges most from the average of the sample. Risk is defined as the difference (positive or negative) between a portfolio's return and that of the unweighted average of the sample. This is referred to here as "absolute" risk and is the main measure used.

With absolute risk a big positive difference (outperformance) is treated as just as risky as a big negative difference. This is because high risk taking should, in theory, sometimes be rewarded with higher returns; if risk taking always ended in failure the market would be even more inefficient than its critics claim. For this reason, the absolute value of the difference is used mainly in this study; for example -3 is treated the same as +3.

Figure 2: The dispersion of portfolio risk 2009

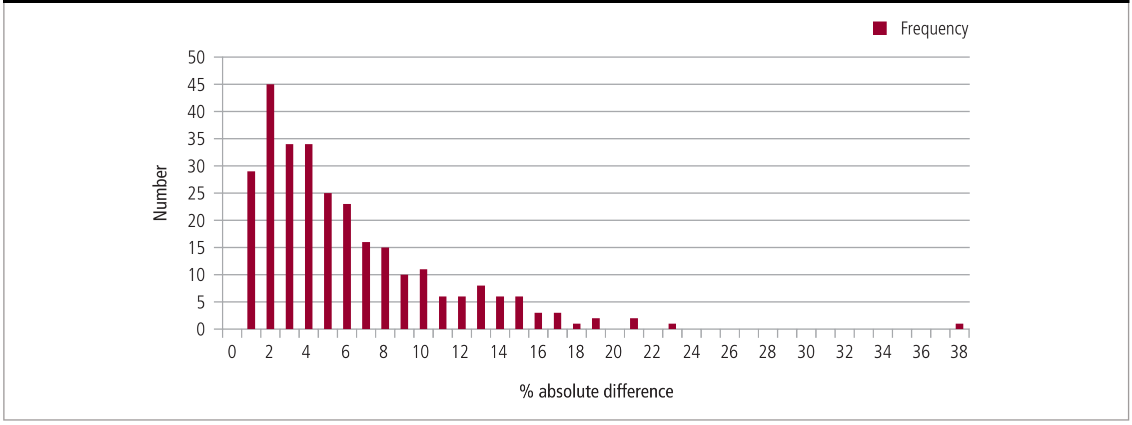


Figure 2 shows the distribution of risk in 2009 for the end 2008 sample of portfolios. Risk, the portfolio return less the average return of the 259 portfolios in the sample, is shown on the horizontal axis and the number of portfolios per level of risk is shown vertically. Because it is measured in absolute terms, there are no negative values; those further to the right are riskier than the "trackers" hugging the left hand side. As this measure is based on differences in total return over the following year, it is referred to here as TR1.

In 2009 the mean TR1 was 5.2% with a range of +/- 4.1% for four fifths of the portfolios, reflecting a turbulent year in which portfolio returns diverged much more than they had in previous years. The risk shown in Figure 2 is, of course, not all the risk to which the portfolios were exposed. Since it depicts the chances of divergence from the average, it does not address market risk.

On the basis of the 259 portfolio sample, the chances of would-be trackers getting their TR1 down below 1% in 2009 was just under 10% and only 25% got within +/-200bps. Of course, not all portfolios in the sample were seeking to track but this seems a low percentage given the nature of investment mandates that frequently require managers to stay within certain parameters relative to their benchmarks, albeit over a three to five year period. For this reason, the study looked at risk over two and three years forward, not just the next year.

The dispersion in Figure 2 is characterised by a long tail of portfolios to the right, in all probability mainly populated by specialist portfolios concentrated in a particular property type or region, or those with only a few properties. The length of this tail, together with the mean value, could be taken as a measure of risk in the sample generally. The 2009 dispersion is much larger than the equivalent dispersion in 2008, where the tail had virtually petered out at the +/-8.5% mark.

The variety of risk measures in use probably reflects the fact that no single measure offers a perfect solution. Using absolute differences in return recognises that risk taking can pay off. Also, it avoids the problem of positive and negative values self cancelling when being correlated with a potential risk factor, which could happen if some portfolios did well at the same time as others proved unsuccessful. An example of this would be a portfolio with a concentration of lease expiries that were successfully re-leased, as against others that were not.

However, a number of behavioural studies have revealed that people tend to weigh losses more heavily than they do gains. The study, therefore, used a variant measure of TR that only recognised negative differences in portfolio performance to reflect this risk aversion, any positive difference being treated as zero. This is referred to here as "downside only" (DSO) TR. It is used as a supplemental way to identify significant risk factors and to check on the results derived using absolute values.

Finally, on a few occasions risk has been analysed with the signs (positive/negative) still attached to address specific issues arising from the research. This is referred to as "nominal" TR.

Nominal measures highlights significance when the sign on the observed relationship changes through time; a factor may add to relative performance in one year and detract from it in another. DSO and nominal versions of TR have been used when the results from the absolute analysis were ambiguous and required further investigation.

2.2.1 Components of total return

Since the issue of investment style in property is of growing interest, it was decided to carry out parallel analyses on components of return differences: the absolute difference in capital returns (CG), in income returns (IR) and income growth (NIG). To prevent the number of analyses growing exponentially, these parallel tests were mainly limited to the initial correlation of factors (see 2.5 below).

2.2.2 Leveraged returns

The increased use of debt in UK markets is one of the most striking changes to the profile of institutional investment in UK commercial real estate since Risk Web 1.0. It is estimated that by mid-2010 the volume of debt secured against commercial property in the UK exceeded the capital value of the IPD Universe.

In order to properly reflect the effect of leverage on risk it was necessary to reiterate the tests with leveraged returns as opposed to the unleveraged returns described above. Since most of the 250+ portfolios making up the full sample did not use debt (as the returns used related to direct assets only) the impact of leverage was assessed by repeating the tests on those portfolios that were members of the Association of Real Estate Funds (AREF).

Sample size increased significantly between 2001 and 2008, reflecting the growth in the AREF fund universe but this dictated that significant results were not available before 2002. Only TR was evaluated so as to reduce the volume of tests.

Results for the AREF sample are presented separately in section 4, although it will be seen that, leverage aside, there are a number of similarities in the results.

The risk from leverage, accessed by funds investing through indirect vehicles, was picked up by a separate factor, proxying exposure to indirect vehicles for the whole sample.

2.2.3 Time horizons

Initially the approach was to relate potential risk factors to absolute relative returns in the following year. However, in preliminary discussion it was pointed out that any portfolio could be expected to experience random one-off events that would significantly impact returns in the year in question. Examples included a change in valuer, investment manager or taxation and the impact of natural events such as flooding. In aggregate, the effect of these one-off events would be likely to create a kind of white noise obscuring the effect of the risk factors. However, over two or three years it was suggested the effect of this white noise could be expected to dissipate.

So, notwithstanding concerns about the congruency of the properties underlying the risk factors with the properties delivering the subsequent performance, it was decided to extend the definition of TR to include a two and three year average. A two-year TR time horizon is the simple average of the two years' individual TR scores and a three-year TR the average of three years. If the white noise hypothesis was correct, one would expect to see better results at a two- or three-year time horizon than over one year forward as the noise dissipated; and, as the white noise impact is reduced over TR2 and TR3, so the change in the risk factors should increase.

2.3 The risk factors

In all 43 factors were assessed. They included most of those in Risk Web 1.0 plus a number of suggestions by the sponsors of the IPF and the Research Steering Group made during the course of the study. The Appendix provides a more detailed description of each factor. At their core were four factors concerned with portfolio exposure by value to:

- Property type (irrespective of region);
- Region (irrespective of type);
- IPD PAS segment (combines property type and region);
- Average lease term (split into five-year bands, for example zero to five; six to 10, where a vacant unit has a term of zero).

The risk of exposure to each of these four factors was measured in four ways:

- A simple measure of portfolio concentration in each of the above categories relative to the year sample as a whole;
- A portfolio beta, estimated by calculating the beta (estimated using market performance data from 1981 to 2009) of each of the four ways of classifying exposure listed above and then calculating a value weighted average for the portfolio;
- As in the previous bullet, except volatility was used instead of beta;
- As previously, except absolute tracking error was used.

These four forms of risk measure were applied to each of the four types of portfolio characteristics to produce 16 factors (four by four). All 16 factors were expected to be positively correlated with risk as defined here. In other words, higher scores were expected to be associated with higher subsequent differences in performance.

Around this core were added a further 27 factors, which can be loosely collated into four groups set out below.

2.3.1 Stock concentration

- Percentage of portfolio value concentrated in the five largest assets;
- Percentage of portfolio value concentrated in lot sizes valued at greater than +£100m;
- Number of assets;
- Average lot size.

A positive correlation with risk was expected the higher the degree of stock concentration (except for number of assets where larger values depict reduced stock concentration).

The factor focussing on very large lot sizes was expected to correlate with risk in markets where values were falling due to their relative illiquidity.

2.3.2 Growth-related factors

These were factors that describe portfolios' orientation towards growth as a source of returns rather than income:

- Equivalent yield relative to the sample average; this was calculated as a ratio to the average equivalent yield of the sample;
- Previous year's ratio of capital to total return;
- Reversionary potential (measured as passing rent over ERV);
- Exposure to central London property (all sectors); effectively a simpler version of the type and region factors;
- Vacant stock (as a % of portfolio ERV); this could equally have been put in the income group but vacancy does imply subsequent income growth.

All factors were expected to be positively linked with subsequent risk, with the exception of the first, where a lower relative yield was seen as likely to lead to greater risk because income is more certain than future growth. As capital growth is less certain than income return, a wider spread of portfolio returns would be expected by funds more exposed to growth.

2.3.3 Income-related factors

These were factors that might be expected to concern income-oriented portfolios and strategies:

- Average portfolio covenant strength relative to the sample mean; negative correlation anticipated;
- Covenant strength times reversionary potential; covenant was seen as mattering more to overrented portfolios; positive correlation expected;
- Proportion of portfolio income let to tenants in the three riskiest covenant classes; positive correlation expected;
- As above, except factor limited to the two riskiest covenant classes;

- Concentration of portfolio income let to tenants rated in the two riskiest covenant classes; positive correlation with risk expected;
- As above, except covenant risk multiplied by reversionary potential;
- Tenant concentration, as measured by percentage of portfolio value occupied by 10 largest tenants; positive correlation with risk expected;
- Percentage of portfolio value represented by leases with less than five years remaining, including vacant property); positive correlation expected;
- Mean years outstanding on portfolio leases; negative correlation expected so longer leases would be less risky.

2.3.4 Manager activity

All of the factors below were expected to have positive correlations with risk:

- Leverage, defined as net debt divided by gross asset value (AREF sample only);
- Percentage of value in developments notified to IPD;
- Percentage of value in land;
- Capital expenditure as a percentage of end year value;
- Capital receipts as a percentage of end year value;
- Net investment as a percentage of end year value;
- Total purchases and sales as a percentage of year end value;
- Exposure to assets other than direct assets; principally vehicles, derivatives and overseas properties;
- Portfolio risk in the previous year.

Not all of these factors were expected to produce a significant relationship with subsequent portfolio risk. Some, for example the four stock concentration measures, were alternative ways of getting at the same source of risk, while others could well prove significantly linked to each other, so to include them both in some scorecard would be to double count their effect. Therefore, an analytic process was needed to reduce the number of factors so as to minimise the correlation between them and maximise the explanation of subsequent portfolio risk.

2.4 Evaluating the factors

It should be remembered that the study focussed on the risk of differences in individual portfolio returns to the average return. Most managers, in building their portfolios, will have sought to manage and diversify a proportion of total risk. The analysis focussed on the residual risk they had either inadvertently retained or deliberately built in as a part of some strategy; for example, specialist sector or value add. Statistically this makes the job harder than the usual analyses of market variance, there being less risk left to explain.

To help test what would be an acceptable level of linkage, the study examined how good past volatility is as a predictor of future risk, as defined here. Past volatility of portfolio returns is seen by many as a proxy for portfolio risk and any linkage that might have been derived would set a standard for this study to improve upon.

2. APPROACH

Continuous returns to 145 portfolios over the 10-year period since 1999 were analysed. Selecting this period was the result of a compromise between sample size and the length of data needed to generate a sensible measure of volatility; in this exercise the standard deviation of returns was used.

Over the 10-year period there was a +0.12 correlation between 10-year volatility and 10-year average returns. A correlation of 1 indicates a perfect match; -1 indicates the mirror opposite, a perfect negative match. A score near zero suggests no linkage. So either the fabled efficient market did not exist between 1999 and 2009 or volatility of returns was a poor proxy for portfolio risk.

Past volatility had a better correlation with 2009 returns: -0.18. Portfolios with a more volatile track record did relatively poorly in 2009, when real capital values were falling. Past volatility's correlation with risk (as defined here) was +0.08; portfolios with a more volatile past tended to show greater absolute differences in 2009. However, the 0.08 correlation is low—much lower than the -0.18 linkage with total return.

Several conclusions can be drawn from this. First, the poor showing of past volatility confirms that it is worthwhile exploring other factors to see if they do better. Second, it illustrates that trying to explain return differences is tougher than dealing with risk as a whole. Volatility may be a useful concept for measuring market risk but it seems to be less than useful in dealing with portfolios. Third, it frames expectations for the results. It would be important to see better results than those achieved by simply using past volatility, correlations significantly greater than +/-0.08.

With 43 factors, three time horizons, two portfolio samples and data over 11 years it can be seen that some kind of analytic process was needed to winnow the wheat from the chaff and, indeed, to define what was to be recognised as "wheat".

It was decided to look for factors with the following characteristics:

- Correlated with next year's risk, with the anticipated sign over the majority of years analysed; the one-year time horizon was used since, if this condition was met, the same would be true for two and three years;
- Significant correlation in the last three years, when capital values were falling and portfolio returns would be stressed;
- Not strongly correlated in its own right, but frequently appearing in regressions, helping to improve the quality of the equation "explaining" portfolio risk;
- While not correlating with absolute difference, significant linkages exist with downside (negative values only) risk;
- Not significantly and strongly correlated with other the preferred factors measure.

Of the above, the last point is a necessary requirement. If two factors were strongly linked, including them both in a scorecard would double count the same source of risk. By significant is meant a correlation that has at least less than 10:1 against chance of being a pure fluke, ideally less than 20:1 was preferred.

It should be noted that a distinction must be drawn between the strength of a correlation and its significance, as they are not quite the same thing. As has been mentioned, correlation strength is measured on a scale from -1 to +1, but this estimate is always qualified by the confidence one has in the estimate. In this study, the confidence level of 95% is usually adopted so correlations with lower levels of confidence are not relied upon. At the 95% level the odds of the correlation being just chance are 20 to 1 against. Thus, it is possible to have quite low correlations that are significant, although, generally, high correlations tend to have higher levels of probability that they are not generated by pure chance.

2.5 Process

The first step in the process was to assemble and clean the data of anomalies and extreme outliers that might otherwise have invalidated the results.

The study then embarked on a three phase process. First, all the portfolio factors excluding indirect holdings and leverage, ie direct properties, were related to differences in return based on direct properties only. This effectively repeated the Risk Web 1.0 approach. Then indirect assets were taken into account. These were largely exposures to co-mingled vehicles of various sorts, but also included derivatives, quoted company shares and any asset not classified as a direct holding. The factor, described as "% indirect" was thought to be a reasonable proxy for the growing exposure of portfolios to vehicles, a factor not included in the original risk web. The answers to three questions were sought from this phase:

- Did fund returns (as distinct from direct asset returns) exhibit more risk?
- Was the addition of indirectly held assets a source of that risk in itself?
- Did the existence of indirect assets change the factors that had been present at the direct only level?

Finally, leverage was introduced into the analysis, focussing on the AREF sample of portfolios and using leveraged returns as reported by PPFI. Answers to the same three questions were sought (section 4). How much did leverage increase risk, did its effect vary through time and what effect did adding leverage as a risk factor have on the other factors?

In each phase, correlation analyses were conducted between the candidate factors and total return differences in the full sample over the one-year time horizon. In the first phase, tests were also conducted on components of return. At this stage, simple OLS models[1] were produced to search for factors not particularly significant in their own right but working well with other factors. The overall quality of explanation of the OLS models was also used as an indicator of the significance of the factors in any particular time period.

Then, these first two steps were repeated for the two- and three-year risk horizons to test the hypothesis that one-year linkages would be obscured by random events or noise. The above was then repeated for the second phase (concerned with evaluating % indirect) and then again, introducing leverage and using leveraged returns. Only total return was used in these two phases. Finally, dispersions of selected factors were examined to see if critical values existed, above which the factor became more strongly linked to risk.

The results of these exercises produced the basis for several regression models of future risk with interesting levels of significance and short lists of selected factors for a risk scorecard.

[1] OLS stands for ordinary least squares, a simple means of quantifying the combined linkage between a set of factors and some variable; otherwise referred to here as regression.

3.1 Total return risk one year forward (TR1)

The sample comprised portfolios making up the bulk of IPD's annually valued universe, numbering 259 portfolios at end 2008 and 198 when the data started at end 1998. In each year the risk factors were correlated with TR1 for each portfolio between 1999 and 2008. The 11-year period starts just before the mini recession in the early part of the decade, when in 2001 to 2002 real value change was negative, spans the boom of 2003 to 2006, and ends in the recent regime of falling values.

Table 1 below sets out trends between 1999 and 2009 in average portfolio tracking error one year forward (TR1). Results for capital return differences (CG1) and IR1 are also shown.

Table 1: Trends in risk (one year time horizon)

	Mean differences					
Year	TR	CG	IR	Mean vacancy	Segment concen	Real cap ch (%)
1999	1.9	1.8	0.8	2.1	0.15	5.4
2000	2.6	2.4	0.7	1.9	0.17	0.7
2001	2.3	2.1	0.7	2.1	0.18	-0.6
2002	2.0	1.8	0.5	3.3	0.16	-0.3
2003	2.7	2.5	0.7	3.9	0.18	1.1
2004	2.4	2.4	0.7	4.4	0.20	7.9
2005	2.1	2.1	0.6	4.6	0.20	10.6
2006	2.8	2.8	0.5	4.2	0.20	8.2
2007	3.1	3.1	0.5	3.4	0.20	-11.7
2008	3.0	2.7	0.6	5.7	0.23	-27.3
2009	5.2	4.7	0.9	6.5	0.23	-6.0

Note: based on one year absolute differences in unleveraged returns

Over the past 10 years TR has steadily risen, perhaps reflecting the increase in the presence of specialist funds. As the table shows, segment concentration was also rising throughout the period, while vacancy rate followed a cyclical but rising pattern, especially over the last couple of years. From 2006, when real capital returns went negative, TR and CG have spiked upwards as portfolios' reaction to events diverged. At the same time, the portfolios' dispersion around these means has increased, especially since 2005. In 2009 mean TR grew rapidly, as did the dispersion around it. It will be recalled that 2009 saw a rapid recovery in values, driven by yield compression at the prime end of the markets. Clearly, not all portfolios shared in the recovery.

Trends in TR seem to be largely a function of trends in CG, income return tracking error playing a relatively small part in TR until 2009, when the 50bps spread suggests income variance was beginning to make a difference.

Inspection of average factor values reveals that, by the end of 2008, several risk factors were sharply higher. Apart from vacancy rate, 2008 had seen a rapid increase in sales, net investment fell from +0.8% of end year value in 2007 to -7.2% in 2008. These factors could have caused fund returns to diverge in 2009. Although the available run of data (only 11 periods) is not long enough to attempt meaningful statistical analysis, TR1 has a 0.68 correlation with average portfolio vacancy rate and a 0.73 correlation with segment concentration. In a few years time, this may prove a fruitful line of research, as mean TR1 is, in itself, a measure of risk in the market, high values of TR1 being associated with higher portfolio tracking error in the market as a whole.

Table 1 shows that TR1 is, on average, largely due to capital return risk (CG1), as the two means are very similar through time. However, IR reappeared in 2008/9 and was a larger share of TR1. This is explored further in section 3.2.2 below.

Figure 2, on page 11, showed the dispersion of TR in 2009. Since it is expressed in absolute terms, it cannot have negative values. Given that constraint, the dispersion is fairly normal, although obviously skewed to the right. In terms of linear correlation analysis, better fits may well be achieved by transforming the variable. Research revealed the 2009 distribution to be fairly typical of previous years. This is explored later, when the predictive value of the risk factors are assessed and developed (sections 3.4 and 5.3).

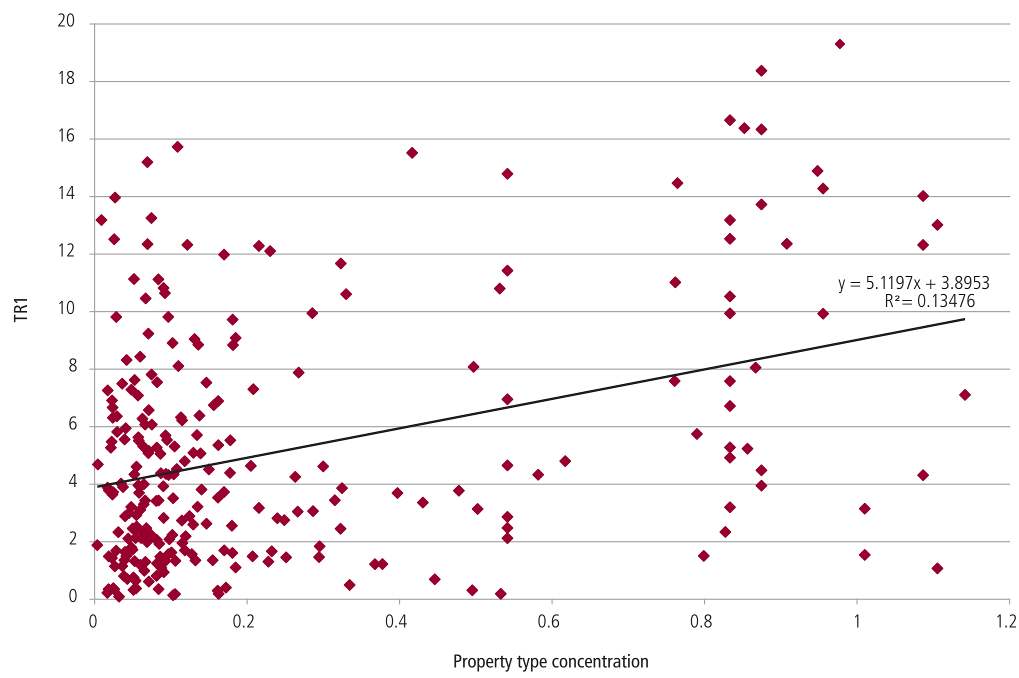
Table 2, which occupies the following page, summarises correlations between the 41 risk factors (excluding leverage and % indirect) and TR the following year. To facilitate interpretation, only correlations significant at the 95% level have been used. The table shows the number of years a significant correlation between TR1 and/or -TR1 (downside only TR) occurred, together with frequency in the last three years and the number of times a factor appears in an OLS regression, which combines factors to "explain" risk.

Table 2: Risk factors significantly linked with TR the following year

Risk Factor	No. yrs absolute	Sig @ 95% downside only	No. in 06/08 absolute	Years in OLS	Preferred
PAS segment					
Weighted beta	3	4	0	3	
Weighted tracking error	6	7	1	1	
Weighted volatility	3	4	0	0	
Concentration ratio	11	9	3	3	
Region					
Weighted beta	7	7	3	0	
Weighted tracking error	4	7	0	1	
Weighted volatility	7	7	3	0	
Concentration ratio	11	8	3	0	*
Property type					
Weighted beta	3	4	1	0	
Weighted tracking error	3	6	3	5	*
Weighted volatility	2	5	0	3	
Concentration ratio	11	10	3	4	*
Remaining lease length					
Weighted beta	4	6	1	2	
Weighted tracking error	2	4	0	2	
Weighted volatility	1	5	1	1	
Concentration ratio	9	5	3	3	*
Stock concentration					
% value five largest assets	10	8	3	4	*
% value +£100m assets	4	6	2	2	
No. assets	6	2	2	0	
Av. lot size	7	6	2	1	*
Growth					
Relative eq. yield	3	7	1	2	*
Capital/ total return ratio	4	4	1	3	
Reversion potential	3	4	0	1	
% value central London	8	8	3	0	
Vacancy rate	2	6	0	2	*
Income					
Covenant strength	1	5	0	1	*
Covenant strength *rev pot	0	5	0	0	
% value top three risk classes	0	1	0	0	
% value top two risk classes	0	1	0	2	
Top two classes *%+10yr leases	1	1	1	2	
% value top 10 tenants	8	4	3	4	*
% value sub five-year leases	2	5	0	0	
Mean years remaining	2	2	1	2	
Top two classes *rev pot	0	1	0	2	
Manager activity					
% development	1	3	0	1	*
% land	2	0	1	1	
Cap expenditure	1	0	0	0	
Cap receipts	1	1	0	1	
Net investment	0	2	0	2	
Turnover	1	0	0	0	
TR in previous year	9	4	3	6	*

The majority of the 13 risk factors selected are structural measures of various types of portfolio concentration: region, segment, property type, stock, tenant and the timing of lease termination. The consistent theme is the need to diversify in a number of dimensions to reduce risk, a key feature of Risk Web 1.0. Outside of these concentration factors, the level of TR in the previous year was found to be important, as were several measures of inferred portfolio variance, beta and tracking error. Figure 3 shows one of these concentration ratios, property type, plotted against TR1 on the vertical axis. Each portfolio is represented by a dot. The majority of portfolios are clustered in the bottom left corner of the graph; their property type spread is a reasonably close match to the sample as a whole. As concentration on a few types increases the TR1 steadily rises too, but it is not an even pattern. There is a clear break between type concentration scores of 0.65 and 0.75, where there are no portfolios. This, if repeated in earlier years (which it is), represents a critical value for this factor. To the left of this break, type concentration is not particularly relevant; to the right of it, the factor is an increasing source of portfolio risk.

Figure 3: Property type concentration 2008 and TR1



Lease end concentration reflects the increased risk in a portfolio of a bunching of re-leasing exposure relative to the whole sample. Other things being equal, this will be reflected in an upward pressure on portfolio equivalent yield and consequent loss in value as the bunching gets closer to the present day. The significance of this reflects the importance of income to property as an asset class, comprising, as it does, the bulk of long run returns. It may also be picking up increased concern about lease length. At December 1998 the average term remaining in the sample's leases was 13.8 years, by December 2008 this had fallen to 9.0 years. As the mean contracts, clearly increased bunching is likely to occur. Lease end diversification is another tool available to manage portfolio risk.

3. RESULTS FOR DIRECT ASSETS

In absolute terms, TR1 in the previous year was significantly and positively correlated with TR in nine out of the 11 years tested. This may reflect manager style but also could be due to serial correlation in returns. In nominal TR space the pattern of correlations was much less signficant.

Although the previous year's TR1 is not a tangible characteristic in the way the other factors are, it is real enough to those concerned and rewarded by appraisal based performance statistics. Thus, it was included as a factor.

The preferred factors in Table 2 were, virtually without exception, also regularly significant in the downside only analysis and also over the last three years of falling real values; no other factors were, except the weighted tracking error of property types. Therefore, this was added to the list, because it had also emerged as significant over the past three years, as well as appearing five times in OLS regressions "explaining" TR1.

The downside only results echoed the absolute TR correlations in that concentration factors were found to consistently associate with higher TR values. However, downside only also relates more frequently to several growth and income factors that the absolute analysis did not, especially relative equivalent yield, vacancy rate and covenant strength. These factors are associated with poorer relative performance over most of the years covered by the study—when was vacant possession last seen as an advantage? As a result, they show up better when only downside risk is considered; there is no counter balancing upside.

In addition, development exposure was added. This may seem strange, given its poor showing in Table 2. Development averaged only 1 to 3% of portfolio value over the period. At most, this factor reflected a small proportion of the portfolio, so perhaps its failure to correlate is understandable. Its poor correlation flies in the face of conventional experience, which holds that development is a riskier business than held properties. The IPD definition of development does not distinguish speculative from pre-let activity and so it is possible that the flagging process that tags "development" is not isolating the truly risky assets. As a result, considerable effort was devoted to testing factors such as land holdings, capital expenditure and receipts, but to no avail. In view of this, the results for development were reviewed and it was found that, at the 90% confidence level, development significantly correlated with TR1 in 2002 and 2008, both years when real capital growth had been weak for two consecutive years previously.

It seems that development exposure only really becomes a risk on the downside, when it cannot be let or needs refinancing, and that may be reflected in these results, with it only appearing as a significant factor in times of stress after a couple of bad years. Since it is precisely times like these when risk management is of most value, development was included.

The list was, reduced, however, because some factors were highly correlated (+0.7) with other preferred factors or because the sign attaching to the factors' significant correlation changed several times over the years, making them ambiguous and, potentially, misleading indicators. A number were deleted, including PAS concentration and tracking error, the weighted beta, tracking error and region volatility, and % value central London, making a final preferred selection of 12 (asterisked) in Table 2. The 12 factors divide into two groups: nine evergreen or structural factors, significantly related most of the time, and three cyclical, in that they become significant after periods when real capital values have been falling.

The nine structural factors are as follows:

- Region concentration;
- Property type weighted tracking error;
- Property type concentration;
- Remaining lease length concentration;
- Stock concentration: percentage value five largest assets;
- Stock concentration: average lot size;
- Growth: relative equivalent yield;
- Income: percentage value top ten tenants;
- TR in previous year.

Of these, only relative equivalent yield was linked using a downside only definition of risk, suggesting that relatively low yields may be associated with lower relative returns, but the reverse is not proven (that high yields link with higher returns).

Table 3: Cyclical factors, correlation with TR1

	Development			Covenant strength			Vacancy rate		
Year	Absolute	Downside	Nominal	Absolute	Downside	Nominal	Absolute	Downside	Nominal
1999		-0.13	-0.14						
2000			-0.13				-0.21	0.21	
2001									
2002				-0.22	0.31	0.22	0.37	-0.38	-0.27
2003	0.22	-0.35	-0.33		0.24	0.26		-0.27	-0.28
2004									
2005								-0.15	
2006			-0.16		-0.18				
2007					-0.20	-0.20		0.14	
2008		-0.13	-0.15						
2009	0.12	-0.20	-0.19		0.22	0.26		-0.27	-0.36

Note: years relate to year following date of factor
Note: correlations with >90% significance

The correlations of the three cyclical factors are shown in Table 3. It identifies the years when these factors significantly correlated with subsequent TR1. The table shows the results using absolute and downside and nominal values (ie positive and negative data) for TR1. In nominal terms, development is negatively correlated with relative returns in all 11 years bar one, 2007. However, it is in years following weakening markets that this negative correlation tends to become significant. The downside only results confirm the significance of this pattern, with significant negative correlations in 2003, 2008 and 2009, following 2001 to 2002 and 2007 to 2008, when real capital returns were negative.

The results suggest that development rarely adds to returns across the board; in most years, the absence of significant correlation implies there were both winners and losers, with no clear pattern emerging, except after the markets have been under pressure.

Covenant strength did not show up using the absolute definition of TR1 but in both downside only (DSO) and nominal it is associated with lower tracking error (ie less negative) after falls in value. Interestingly, the factor shows negative correlations in 2006 to 2007, perhaps reflecting the yield compression of secondary properties then. Vacancy rate shows a similar cyclical pattern becoming negatively significant in 2002 to 2007 and 2009.

To summarise, these factors only seem to exercise an adverse influence after a fall in values. At other times they are mostly not linked to relative performance. Since risk analysis is at its most useful when markets are under pressure, these factors are included.

3.2 Components of return

The study repeated the exercise described in section 3.1 on components of total return, capital growth (CG) and income return (IR). Table 4, on the following page, compares the incidence of significant correlation co-efficients between TR and its three components. Two years are shown for concision. 2008 factors were selected as being the most recent and, for contrast, 2004 was the year with the highest real capital growth, when CG linked factors should show up. It will be recalled from Table 1 that there was a 50bps difference between TR1 and CG1 in 2008, the largest of the 11 years analysed. If any year was going to be evident differences in the factors linked with TR and CG it was going to be 2008.

3.2.1 Total return and capital growth

Little difference was observed between the results for TR and CG. With only two exceptions factors linked with TR were also linked with CG. The same result was achieved in 2004. Similar congruency was observed in other years. Given these findings, it was decided to prioritise work on TR rather than CG.

3.2.2 Income-related factors

However, as can be seen in Table 4, IR1 and NIG1 did relate to a different set of factors, and this may of relevance to investors placing a greater emphasis on income and income growth than on appraisal based total returns.

It is well established that income is by far the largest proportion of total property returns over the long term, when the effects of yield shift has largely self cancelled. Thus factors that impact income return and growth long term will affect value but they may not show up near-term, being obscured by shifts in yield and lease structure. The long-term investor, therefore, may well place more importance on income-related factors than those affecting value.

In common with TR and CG, IR is strongly and consistently associated with concentration factors, and with IR in the preceding year. It is much more influenced by income factors than CG, especially exposure to the two riskiest covenant groups and tenant concentration over the last three years, (2007 to 2009), when real values have been falling; but not before 2006. Over these last three years, IR is much less correlated with stock concentration factors than is CG and TR. Perhaps this reflects the steady erosion of discounts for large properties as the last boom developed.

Table 4: Correlations by return component significant @ 95% level

Risk	2008				2004			
Factor	TR	CG	IR	NIG	TR	CG	IR	NIG
PAS segment								
Weighted beta	-0.12	-0.13		0.17				0.15
Weighted tracking error								
Weighted volatility				0.16				
Concentration ratio	0.32	0.31	0.19		0.21	0.26	0.31	
Region								
Weighted beta	-0.14	-0.14	0.23	0.13				
Weighted tracking error			0.27	0.12				
Weighted volatility	-0.14	-0.14	0.25	0.14				
Concentration ratio	0.17	0.16	0.29		0.16	0.17	0.25	
Property type								
Weighted beta	-0.14	-0.17		0.20				
Weighted tracking error	0.15	0.17		-0.12				
Weighted volatility				0.18				
Concentration ratio	0.36	0.36			0.17	0.21	0.32	
Remaining lease length								
Weighted beta			-0.27		-0.18			
Weighted tracking error				0.18				
Weighted volatility			-0.17	0.13	-0.16			
Concentration ratio	0.33	0.33	0.17		0.19	0.16	0.19	
Stock concentration								
% value five largest assets	0.30	0.25	0.19		0.24	0.25	0.22	
% value +£100m assets	0.19	0.20			0.24	0.24	0.31	
No. assets	-0.17							
Av. lot size	0.21	0.21			0.29	0.27	0.21	
Growth								
Relative eq. yield				0.14	0.15		0.16	
Capital/ total return ratio					-0.16	-0.20		
Reversion potential				-0.19			-0.19	
% value central London	-0.14	-0.14	0.24	0.13				
Vacancy rate							0.16	
Income								
Covenant strength					-0.16			
Covenant strength *rev pot								
% value top three risk classes								
% value top two risk classes			0.15					
Top two classes *%+10yr leases				-0.12				
% value top 10 tenants	0.15		0.23					
% value sub five-year leases			0.14	0.15				
Mean years remaining				-0.19				
Top two classes *rev pot	0.15							
Manager activity								
% development	0.12	0.13		0.28				
% land			0.25		0.19			
Cap expenditure								
Cap receipts				0.21	0.23	0.21		
Net investment								
Turnover								
TR in previous year	0.23	0.22	0.13		0.18	0.21		

Note: based on absolute values of TR1

Similarly, the relative equivalent yield, which was a positive influence on IR1, ceased to be after 2005, just when it starts to correlate with CG.

As might be expected percentage land has a positive influence, as land does not generate income. IR is strongly affected by regional variance factors (beta tracking error, volatility) from 2005 but not at all by variance in property type. On this evidence, regional diversification may well matter more to income investors than the type of property.

As can be seen in Table 4, in 2008, differences in income related much more to region than to type. As might be expected in a regime of falling values, they were also significantly linked to income factors such as covenant risk and remaining lease term. In 2004, when capital values were rising fast, income factors did not feature and IR1 was linked to much the same factors as TR1 and CG1. This suggests the factors affecting income specifically are in some way cyclical, perhaps reciprocating with capital growth related factors.

This proposition was tested by generating some simple OLS regressions based on a stepwise program accepting factors with a 90% significance. Table 6, below, compares the resulting RSQ[2] of the capital and income equations. For year ends preceding years when real values were falling (2001 to 2002 and 2007 to 2008), the income factors produced better results in four out of the five years and there was hardly anything between them in the fifth (2007). This suggests considerations of income matter less when values are rising and relatively more when they are falling. However, this conclusion should not be overstated as differences in income return are less than capital differences.

Covenant risk and strength and percentage of sub five-year leases correlate significantly on a number of occasions, which supports the findings in section 3.1 above. But vacancy rate only correlated with IR1 twice, in 2001 and 2004.

The conclusion to be drawn from this is that factors affecting IR are more relevant on the downside when values are under pressure, in which case the length and quality of the portfolio's contracted income becomes important for income risk. This effect is less marked at the TR level, as IR risk is a small proportion of TR risk (Table 1). Since most investors are primarily concerned with total return risk, it was decided to concentrate on total return. It may be worth returning to the longer term impact of income risk in a later study, since value and income-oriented investment styles frequently take a longer term view of risk.

3.3 The effect of extending the time horizon

Property portfolio returns are frequently subject to idiosyncratic events, such as a change in valuer, the addition or removal of very large assets, changes in manager or the tax environment. It is possible, therefore, that a proportion of the variance observed in portfolio returns may reflect these fundamentally random or one-off events and so be essentially inexplicable. The predominance of such property specific factors was highlighted in research by Mark Callender in 2006 *(Risk Reduction and Diversification),* which focussed on the inadequacies of the conventional top down descriptors in explaining variance.

However, over two or three years there is an increasing chance that the effect of these events will self cancel, leaving a greater proportion of potentially explainable variance in returns behind. If this was the case, better correlations should be obtained over a two- or three-year time span. Any longer than this would subject the analysis to the criticism that the performance was coming from a different set of assets to those whose risk factors were observed.

[2] RSQ measures the extent to which variance in a factor is linked to variance in a set of determinants. Its value ranges from 0 to 1, where 1 is a perfect explanation of the factor's variance. RSQs with values of less than 0.3 may usually be disregarded.

Table 5: Effect of extending the time horizon, 2006

Risk	Correlations over 95%		
Factor	2007	2007 to 2008	2007 to 2009
PAS segment			
Weighted beta			
Weighted tracking error	0.24	0.19	
Weighted volatility			
Concentration ratio	0.26	0.36	0.48
Region			
Weighted beta	0.14	0.22	
Weighted tracking error			
Weighted volatility	0.14	0.21	
Concentration ratio	0.22	0.34	0.42
Property type			
Weighted beta			
Weighted tracking error	0.22		
Weighted volatility			
Concentration ratio	0.23	0.31	0.43
Remaining lease length			
Weighted beta	-0.15	-0.28	
Weighted tracking error			
Weighted volatility	-0.15	-0.24	
Concentration ratio		0.26	0.35
Stock concentration			
% value five largest assets	0.14	0.24	0.35
% value +£100m assets			0.29
No. assets			
Av. lot size		0.15	0.29
Growth			
Relative eq. yield	-0.16		
Capital/ total return ratio			
Reversion potential			
% value central London	0.15	0.24	
Vacancy rate		-0.20	
Income			
Covenant strength			
Covenant strength *rev pot			
% value top three risk classes			
% value top two risk classes		0.14	
Top two classes* %+10yr leases	0.14		
% value top 10 tenants	0.15	0.22	0.20
% value sub five-year leases			
Mean years remaining	0.14		
Top two classes *rev pot			
Manager activity			
% development			
% land	0.15	0.28	
Cap expenditure			
Cap receipts			
Net investment			
Turnover			
% value indirect			
TR in previous year	0.18	0.28	0.33

This proved to be the case. In every year tested, correlations improved over two and three years. Table 5 shows results for 2006 looking one, two and three years ahead. Compared with the one-year period, looking forward two years yields much better results and three years tends to be better than two. The five concentration factors (tenant, lease-end, top five assets, +£100m lots and PAS segment) continue to be significant. Vacancy, development, net investment and the two covenant factors rarely show any significant linkage.

The effect of extending the time horizon can be assessed more accurately than just counting correlations, by conducting regressions of the factors against the three time horizons of TR. This avoids the problem of double counting the effect of one source of risk . To do this, multiple regressions were conducted on all the data, including factors down to a confidence interval of 90% (ie chances of the result being pure luck are 10 to 1 against).

Table 6: Performance of regressions by time horizon and return components

Year end	TR1	TR2	TR3	CG1	IR1
1998	0.27	0.34	0.25	0.21	0.25
1999	0.30	0.22	0.33	0.33	0.24
2000	0.19	0.41	0.38	0.29	0.41
2001	0.48	0.56	0.48	0.14	0.54
2002	0.54	0.50	0.46	0.57	0.12
2003	0.13	0.26	0.49	0.20	0.24
2004	0.24	0.44	0.47	0.17	0.26
2005	0.36	0.51	0.58	0.37	0.21
2006	0.27	0.39	0.30	0.25	0.37
2007	0.26	0.32	-	0.22	0.20
2008	0.20	-	-	0.22	0.27
Mean RSQ	0.295	0.395	0.416	0.28	0.29

Table 6 shows a summary of the results of this exercise, using the RSQ as a measure of the amount of TR variation explained collectively by all the factors. It shows that results improve significantly when a two-year horizon is adopted, confirming the hypothesis that there is noise obscuring linkages at the one-year horizon. No significant improvement was made by going to three years. Similar results were found for CG, suggesting that estimates for future risk from these factors would best be made over a two-year period.

3.4 Forecasting TR

The OLS regressions, whose quality of fit was shown in the last section, are a fairly naïve way of seeking to forecast. They can, potentially, be improved by allowing for non-linear relationships, which, in the light of the dispersion of the dependent variable (see Figure 1), should improve matters. This section reports on attempts to predict over one- and two-year horizons for the most recent years, using data as at end 2006, end 2007 and end 2008. These years were selected as they are the most recent, although, as the regressions in Table 6 demonstrated, they were likely to produce the poorest results.

In attempting to generate a forecasting model, attention focussed on the 12 preferred factors reported earlier. A variety of non-linear transforms were tested but, ultimately, none were adopted as they did not add significantly to the overall quality of the explanation. Looking over one-year forward (2008 TR1), a six factor model was developed in which all of the factors were significant or nearly so. Results are set out in Table 7 below. Overall, the results of the model are unconvincing. An adjusted RSQ of 0.18 was better than that achieved by simply looking at prior portfolio volatility and better than the correlation coefficents for the factors individually, but not good enough to be relied upon for forecasting the TR of a portfolio.

The same model was applied to a two-year time span from 2007 and a three-year time span from 2006. Results are also shown in Table 7. The adjusted RSQ of the models rise, reflecting the removal of one-year noise from the data, a characteristic also seen in Table 6 results. However, at best, an RSQ of 0.22 is not good enough. Moreover, the significance of some of the factors weaken, notably development and relative equivalent yield, reflecting the way the relative importance of factors differ from one year to another.

Table 7: Results of multi factor modelling: direct assets

Factor	2008: TR1		2007: TR2		2006: TR3	
	Co-efficient	T stat	Co-efficient	T stat	Co-efficient	T stat
Constant	-6.2	-2.05	1.72	0.81	2.34	1.1
% development	0.09	2.18	0.05	1.69	0.03	0.9
Type concentration	3.2	2.82	2.11	3.26	0.87	3.23
Relative equivalent yield	5.9	2.58	-0.11	-0.06	-0.43	-0.27
Type tracking error	0.81	2.32	0.23	1.02	0.11	0.52
Lease end concentration	3.5	1.82	3.79	3.36	2.29	1.94
Absolute return diff	0.15	1.72	0.05	1.4	0.127	3.01
Adj. RSQ	0.179		0.215		0.223	

Note: leverage is everpresent at a significant level but its strongly increased influence on the downside leads it to be classified as cyclical

3.5 Summary of findings

The research has shown that the typical tracking error in total portfolio returns is in the range of +/- 2% to 3% in any one year. In 2008 to 2009 it was substantially higher; greater market volatility exposed greater differences in the way portfolios perform.

Most of the factors selected do exercise an influence on subsequent tracking error but, in any one year, the combination of factors has varied—there is no "silver bullet" in the form of a simple solution that is good for all points in the cycle (if a cycle, as such, exists).

4. ADDING INDIRECT ASSETS

Factors relating to portfolio concentration are the most reliable indicators though time and across the different components of return. Factors relating to growth (development, covenant strength and vacancy) are most significant after real capital values have fallen. Relative equivalent yield becomes a significant evergreen factor when seen in downside only space. Lower yields are associated with a higher chance of negative tracking error, although the reverse does not apply consistently over the period analysed.

Analysis of multi factor models on recent years' data suggests that, although 12 of the candidate factors are linked to risk, they do not readily combine into a model that could be used for predictive purposes.

It would appear that one-year time horizons give the weakest results, as the strength and significance of linkages consistently improve when two-year and, to a lesser extent, three-year perspectives are taken.

Thus far, the study has been concerned with portfolios of direct property only; their characteristics and their returns. However, some 20%+ of portfolios are now made up of assets other than pure UK properties, so-called "indirect" assets. The second phase of the study, which this section reports, looked at the impact on the direct asset findings by adding in returns from indirect assets.

This was done by replacing total returns to direct assets with those of each portfolio as a whole, whilst introducing a new risk factor: percentage exposure to indirect assets. This in the main, comprised co-mingled vehicles, but also included JVs, derivatives, exposure to quoted companies, overseas assets, cash and a number of miscellaneous items that proved impossible to separate out. What was ultimately included is a far from perfect measure of exposure to vehicles, as it comprises a polyglot of assets—anything in fact that is not a directly held, UK-located property. There is, therefore, considerable potential for mis-specification.

4.1 Impact on portfolio risk

Bearing this in mind, Table 8 compares average TR1 for direct assets (from Table 1) with the average when all assets' returns are taken into account.

Table 8: Effect on TR1 of adding indirect assets to portfolio returns

	Direct only		All assets	
Factor year	TR1	St Dev	TR1	St Dev
1998	1.9	1.6	2.0	1.8
1999	2.6	2.3	2.7	2.4
2000	2.4	2.3	2.5	2.3
2001	2.0	1.9	2.4	2.3
2002	2.7	2.7	3.0	3.3
2003	2.4	2.0	2.7	2.7
2004	2.1	1.8	3.0	3.3
2005	2.8	2.7	3.5	3.4
2006	3.2	2.6	3.4	3.2
2007	3.0	2.7	5.7	5.8
2008	5.2	4.1	6.5	6.7

4. ADDING INDIRECT ASSETS

Adding indirect returns has the effect of raising average TR1 in each of the years covered by the study. Although consistent down the years, this increase is not really significant, as is attested by the sets of attendant standard deviations, which dwarf the difference in returns. The high degree of overlap between the two dispersions suggests that adding indirect has had a mixed effect across the portfolios, some reducing risk and some adding it. This is what one would expect; some indirect exposure will reduce risk by simple stock diversification, others, such as specialist funds or funds using leverage, could increase risk.

4.2 Indirect exposure as a factor

The percentage exposure of portfolios was then added to the set of factors to see if significant linkages could be established. In no year did indirect have a significant linkage with TR1 the next year. As might be expected, the factor did not influence risk embedded in the direct portfolio. There is no evidence, therefore, that managers have been systematically using indirect exposure to reduce relatively risky direct portfolios; rather, the increase in risk in Table 8 implies that the pursuit of increased returns was the key motivation.

Exposure to indirect fared a little better when correlated with overall portfolio returns. However, it was significantly associated at the 95% level on two out of the 11 years. Most of its correlations with TR1 were negative, suggesting a modest degree of risk reduction is precipitated as indirect exposure rises. The link is tenuous.

4.3 Impact on direct asset factors

As might be expected, using total asset returns changes the correlations identified in section 3, but not by much. There is a fairly strong correlation between direct and direct plus indirect returns (0.71 in 2009) and the same factors still come through.

Table 9 below compares the incidence of significant linkages for each of the factors using both types of returns. The two sets are very similar and all the factors selected in section 3 are prominent in Table 9.

4.4 Summary of findings

Fund returns showed slightly more risk than returns based purely on direct assets, a margin that has been sustained over the study period, but the difference was not significant and the variable is potentially mis-specified. Exposure to indirect assets did not show itself as a source of risk in its own right; furthermore, the use of fund returns, instead of direct asset returns only, would not have had any effect on the selection of factors reported in section 3.

A reason for this marginal increase in risk over the years could be the increased use of leverage in vehicles, an issue which is explored in the next section.

Table 9: Effect of adding indirect assets to portfolio returns

Risk	Direct assets only		Direct plus indirect	
Factor	Absolute	Downside only	Absolute	Downside only
PAS segment				
Weighted beta	3	4	4	6
Weighted tracking error	6	7	6	5
Weighted volatility	3	4	4	4
Concentration ratio	11	9	11	6
Region				
Weighted beta	7	7	5	7
Weighted tracking error	4	7	7	6
Weighted volatility	7	7	6	8
Concentration ratio	11	8	11	7
Property type				
Weighted beta	3	4	2	5
Weighted tracking error	3	6	3	8
Weighted volatility	2	5	1	4
Concentration ratio	11	10	11	6
Remaining lease length				
Weighted beta	4	6	4	4
Weighted tracking error	2	4	3	5
Weighted volatility	1	5	3	2
Concentration ratio	9	5	9	4
Stock concentration				
% value five largest assets	10	8	10	7
% value +£100m assets	4	6	5	3
No. assets	6	2	2	3
Av. lot size	7	6	7	4
Growth				
Relative eq. yield	3	7	1	5
Capital/ total return ratio	4	4	5	3
Reversion potential	3	4	3	5
% value central London	8	8	6	7
Vacancy rate	2	6	3	5
Income				
Covenant strength	1	5	1	2
Covenant strength *rev pot	0	5	1	0
% value top three risk classes	0	1	0	2
% value top two risk classes	0	1	1	1
Top two classes *%+10yr leases	1	1	1	2
% value top 10 tenants	8	4	6	5
% value sub five-year leases	2	5	1	3
Mean years remaining	2	2	5	4
Top two classes *rev pot	0	1	1	0
Manager activity				
% development	1	3	1	3
% land	2	0	2	0
Cap expen	1	0	1	0
Cap receipts	1	1	0	0
Net investment	0	2	2	2
Turnover	1	0	1	0
% value indirect	0	2	2	1
TR in previous year	9	4	11	4

(data are number of years when correlation significant at 95% level)

5. THE IMPACT OF LEVERAGE

Leverage has emerged as a key feature of portfolios since Risk Web 1.0 was produced in 2003. However, most funds in the overall sample do not carry significant amounts of debt, other than through indirect vehicles to which they may have had exposure. It was decided, therefore, to focus on the AREF sub-set of the overall sample. This is made up of open- and closed-ended comingled vehicles, which do have the opportunity of borrowing against their directly held assets. It comprised 57 of the 267 portfolios analysed as at December 2008. This sample has expanded rapidly since 2002, when IPD performance records first contained a reasonable number of funds. Prior to that, the sample size is too small for analysis. In 2002, the 33 relevant portfolios had an average leverage (net debt over gross valuation) of just under 11%; by end 2008, the average leverage of the portfolios then in the sample was over 24% (Table 10).

The volume of debt being applied to portfolios steadily rose between 2003 and 2006. That this is not fully reflected in the mean LTV of Table 10 is due to rising capital values. However, when values began to fall in 2007, mean leverage, and with it TR1, began to soar. The impact across portfolios was not uniform as not all funds were leveraged to the same extent.

Table 10: The effect of leverage on TR1

Year	All TR mean unlevered	AREF mean unlevered	AREF mean leveraged TR1	Mean % leverage
2003	2.7	4	5.9	10.8
2004	2.4	2.6	3.9	8.2
2005	2.1	2.6	4.4	12.6
2006	2.8	3.2	5.7	13.9
2007	3.1	3.8	4.9	14.4
2008	3.0	3.9	10.7	19.6
2009	5.2	6.6	14.2	24.4

5.1 The effect of leverage on TR1

The association between leverage and TR1 for 2008 is pictured in Figure 4 on the next page. The graph plots LTV on the horizontal axis and TR1 vertically. The relationship is clearly strongly positive and is also non-linear; in section 5.5 this is explored further, in the context of seeking to forecast leveraged TR1. It can be seen that the distribution rises towards the left slightly, as well as the more pronounced rise to the right. The leftward rise reflects portfolios that had negative leverage, ie they were net cash positive, which helped to differentiate their returns from the average. Note, also, an absence of portfolios in the 30 to 40% range of LTV, reflecting a clear split in the use of debt. To the left of this area, leverage has relatively little effect on TR1; to the right of it, the effect is dramatic, as the influence of leverage cuts in.

What sort of funds were using higher levels of debt to enhance returns?

The study found that the level of LTV at end 2008 was significantly correlated with **unleveraged** returns, a co-efficient of 0.35. In other words, funds with relatively risky portfolios had been seeking to enhance their returns further with more debt. Similar but less significant correlations were found in 2002, 2006 and 2007, when some of this debt originated. Why should this be? Arguably, relatively high risk (and, therefore, prospectively high return) funds were finding it tougher to source product that met or exceeded their investors' expectations as values rose. It is possible that they found debt an effective way of raising prospective returns and as a source of capital to compete for product.

5. THE IMPACT OF LEVERAGE

The influence of debt through the cycle can be illustrated by examining its correlation with TR1 through time in a different light, by looking at nominal and downside only (DSO) measures of TR1 (Table 11 below). Using absolute return differences, the measure largely adopted by this study, LTV is positively and significantly correlated in all but one year, 2005. But the picture changes in the light of nominal and DSO measures. In the first part of the cycle, LTV is positively correlated; the extra risk paid off with higher returns. This changed in 2007 when the correlation turns strongly negative. LTV is a means of adding beta to a fund's performance. It acts like the volume control on a radio, except that you can turn it beyond "off": by being net of cash (a negative LTV), a fund can reduce its fundamental risk. However, as Figure 4 shows, not many funds availed themselves of this facility in 2008.

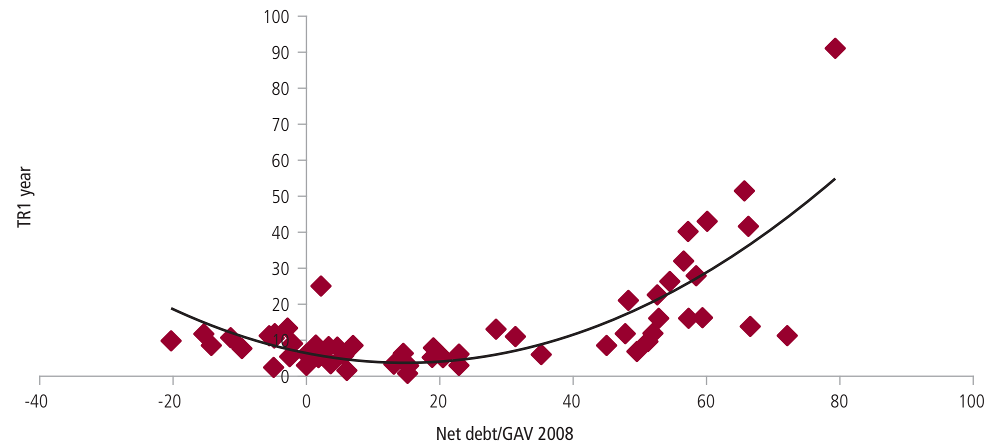
Table 11: Correlation of leverage with TR

Year of TR1	Nominal TR1	Downside only TR1	Absolute		
			TR1	TR2	TR3
2003	0.44	*0.04*	*0.33*	0.49	0.54
2004	0.66	*0.27*	0.61	0.55	0.35
2005	0.54	0.49	*0.28*	0.34	0.42
2006	0.50	0.46	0.20	0.43	0.46
2007	-0.45	-0.52	0.54	0.52	0.60
2008	-0.85	-0.77	0.41	0.53	-
2009	-0.54	-0.58	0.60	-	-

Note: years relate to year following date of factor: all data significant at 95% level except those in italics

Table 11 also shows LTV's correlation with TR2 and TR3. As with the fundamental factors, the correlations tended to rise when longer time periods were analysed, with quite large improvements in some years.

Figure 4: Leverage and TR1 2009



5.2 Leverage's effect on other risk factors' significance

Because the use of leverage changes returns, there is the probability that leverage will affect the significance of other risk factors. This is explored in Table 12 on the following page, which compares the performance of the 43 risk factors on the AREF sample with and without the effect of leverage (left hand side of the table). Leverage does change the results, masking many of the factors identified in section 3.

Table 12: Significant factors AREF sample (TR1)

Risk Factor	Unleveraged: No. yrs sig @ 95%	Unleveraged: Mean correl in signif years	Leveraged: No. yrs sig @ 95%	Leveraged: Mean correl in signif years	Leveraged: No. appears in OLS	Leveraged: Yrs sig @ 95% down side only
PAS segment						
Weighted beta	**4**	0.31	**4**	0.12	1	**4**
Weighted tracking error	3	0.39	2	0.39	1	3
Weighted volatility	3	0.30	3	0.41	0	**5**
Concentration ratio	**5**	0.30	**7**	0.41	0	2
Region						
Weighted beta	**4**	0.34	2	0.56	0	3
Weighted tracking error	2	0.63	2	0.61	1	2
Weighted volatility	**4**	0.34	2	0.58	0	3
Concentration ratio	**4**	0.44	2	0.61	1	1
Property type						
Weighted beta	1	0.44	2	0.20	1	3
Weighted tracking error	2	0.35	3	0.51	3	2
Weighted volatility	3	0.14	0		0	2
Concentration ratio	3	0.36	**4**	0.39	0	2
Remaining lease length						
Weighted beta	1	0.37	1	0.37	1	1
Weighted tracking error	**4**	0.28	3	0.18	0	3
Weighted volatility	2	0.39	1	0.35	1	2
Concentration ratio	1	0.33	1	0.29	0	2
Stock concentration						
% value five largest assets	**4**	0.35	2	0.39	2	1
% value +£100m assets	1	0.28	1	0.32	1	0
No. assets	1	-0.36	1	-0.34	1	1
Av. lot size	1	0.28	1	0.55	0	1
Growth						
Relative eq. yield	3	-0.37	**4**	-0.39	1	0
Capital/ total return ratio	3	0.18	2	0.36	0	1
Reversion potential	0		0		1	2
% value central London	**4**	0.36	2	0.62	1	3
Vacancy rate	0		1	-0.37	0	3
Income						
Covenant strength	0		2	0.34	1	2
Covenant strength *rev pot	0		2	0.32	0	2
% value top three risk classes	0		1	-0.39	1	2
% value top two risk classes	0		0		0	2
Top two classes *%+10yr leases	0		0		0	2
% value top 10 tenants	1	0.33	0		0	**4**
% value sub five-year leases	1	-0.41	**5**	-0.36	1	0
Mean years remaining	1	0.38	2	0.42	1	0
Top two classes *rev pot	0		0		0	2
Manager activity						
% development	1	0.40	0		1	0
% land	0		0		0	1
Cap expenditure	0		0		0	0
Cap receipts	0		0		1	0
Net investment	2	0.04	1	0.41	1	0
Turnover	0		0		0	0
% value indirect	0		0		**4**	0
TR in previous year	3	0.56	**5**	0.60	**4**	3
Leverage	1	0.35	**5**	0.50	**5**	**6**

Factors significant in the majority of the seven years (2002 to 2008) are emboldened. With only a couple of exceptions, the unleveraged factors correspond reasonably well with the results in the full sample presented in section 3. However, when leverage is applied (right hand side of Table 10), the significant factors show substantial depletion. Region and stock concentration are much less important, while covenant factors and relative equivalent yield of the portfolio become important. It would appear that the importance of these income factors' is amplified by the application of leverage.

5.3 OLS analysis of leverage

The presence of leverage makes it easier to forecast portfolio risk, as it improves the combined effect of the factors when fitting OLS regressions (see Table 13). Compared with the full sample and with AREF unleveraged, the leveraged OLS results are much higher. Generally, no new factors emerge in a supporting role, with the exception of exposure to indirect assets (ie anything other than directly held properties), which was a significant factor correlating with CG as well.

Table 13: Performance of AREF regressions by time horizon

	Unleveraged			Leveraged		
Year end	TR1	TR2	TR3	TR1	TR2	TR3
2002	0.80	0.71	0.70	0.90	0.79	0.84
2003	0.66	0.50	0.73	0.79	0.69	0.68
2004	0.52	0.70	0.88	0.72	0.66	0.68
2005	0.81	0.63	0.59	0.49	0.47	0.27
2006	0.56	0.19	0.47	0.65	0.53	0.56
2007	0.18	0.22	-	0.24	0.52	-
2008	0.56	-	-	0.63	-	-
Mean RSQ	**0.584**	**0.491**	**0.673**	**0.631**	**0.610**	**0.606**

Note: data are unadjusted RSQ of stepwise OLS untransformed linear regressions, cut off at 10% interval

AREF results are more significant than ALL but, despite the higher correlation of LTV, the stepwise regressions do not show any improvement beyond the one-year time horizon.

5.4 Do new factors emerge with leverage?

The analysis has highlighted just what an important factor leverage is, especially when values are contracting. Leverage, and especially leverage in excess of 40%, increases subsequent differences in return. Leverage, no doubt, adds to positive return differences on the upside and negative ones on the downside. Leverage also masks the direct asset risk factors, as it changes returns. Instead of the 12 factors identified in section 3, only the following are associated with increased risk to leveraged returns (from Table 10):

- Weighted portfolio beta of PAS segments;
- PAS segment concentration (preferred over type concentration as they are highly correlated and PAS is more strongly associated with TR1);
- Relative equivalent yield;
- Previous year's TR;
- Leverage.

Apart from leverage, most of the above also appear in the 12 factor list of unleveraged direct assets; the others (weighted beta of PAS segments and PAS concentration) are strongly correlated with factors in the 12 (type tracking error and regional and type concentration ratios).

Although exposure to short leases was linked with leveraged returns (Table 12) the negative sign is counter intuitive, it implies portfolios with a preponderance of short leases show less leveraged risk! For this reason it was not included in the above list. Percentage indirect's role as a supporting factor in the OLS regressions was also of interest, but, as the factor was not significantly linked to risk in itself (section 4), it was omitted.

It was decided, therefore, to stick with the 12 factors identified in section 3 as describing the fundamental risk inherent in a portfolio and treat leverage as an overlay that modulates the overall level of portfolio risk.

5.5 Forecasting leveraged total return

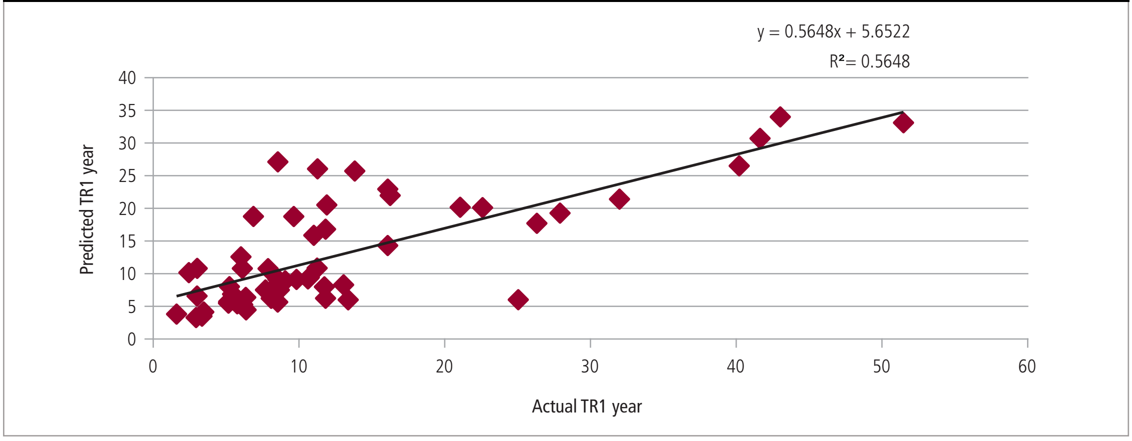
As with the analysis of directly held assets, attempts were made to create forecasting models of TR1. Due to the strength of LTV, the exercise met with rather more success. Again, various non-linear transforms were explored and some fairly significant results achieved (Table 14). Leveraged funds' TR certainly is more tractable. On a one-year forward view an RSQ of 0.54 was achieved; this involved squaring the fund's LTV before using it in the model with a average error of +/-209bps. Predicted and actual results for the funds making up the sample are shown in Figure 5. The key factors in the 2008 model were leverage, the absolute difference in fund returns from 2008 and the degree of segment concentration. Over a two-year time frame from end 2007 much the same factors were significant, although better results were achieved by substituting relative equivalent yield for segment concentration, again reflecting how the mix of factors vary through time.

Although these results were better than their unleveraged equivalents, they are still not good enough for forecasting purposes, an RSQ of 0.54 leaves a lot of risk unexplained.

Table 14: Results of multi factor modelling: leveraged portfolios

Factor	2008: TR1		2007: TR2	
	Co-efficient	T stat	Co-efficient	T stat
Constant	1.54	0.74	18.46	2.4
LTV sq	0.00368	4.72	0.0045	5.6
Absolute return diff	0.469	2.75	0.09	0.5
Segment conc	4.62	1.35		
Relative eq yield			-11.2	-1.5
Adj RSQ	**0.543**		**0.539**	

Figure 5: Predicted versus actual TR1 2008 (AREF sample)



5.6 Summary of findings

Because it directly affects returns, debt drowns out the effect of other sources of risk. In their absence, LTV dominates the causes of risk. This explains why apparently disparate asset classes suddenly started to show high correlations during the financial crisis. Although their fundamental characteristics and risks were different, the presence of debt rendered them as one; or, if not that, then similar enough for the values to move in concert.

Adding debt to a portfolio increases its risk, a risk which rises exponentially as either debt is increased or values fall. A key band between 30% and 40% LTV seems to exist. Below this band modest levels of debt have a limited impact on risk; above it and, as LTV rises, risk soars.

As with the unleveraged sample, the changeable mix of factors appearing in the OLS regressions from year to year suggests that any forecast would have only a limited shelf life. There is also the suggestion that the results, even on a short term basis, could be quite misleading, if applied naïvely to portfolios.

Whilst the results in this section underline the logic of distinguishing between core plus, value added and opportunistic styles on the basis of leverage, they suggest that other factors might be taken into account as well when defining style. Through time it is clear the level of gearing varies both as a function of capital returns and also as a result of management decisions. It is, therefore, quite possible that the level of gearing could reduce relatively quickly, revealing again the direct asset factors that had previously been masked by leverage.

Leverage amplified the downside in values in 2007 and 2008 and attention is focussed now on how to turn the "volume" down through restructuring and refinancing. While current prospects for values are uncertain it is likely that the leverage "volume control" will stay in the off position as debt is paid down but, ultimately, the opportunity to increase leverage and add to returns will re-emerge. It will be intriguing to see how easily the current aversion to debt is overcome and whether more sustainable levels of gearing are adhered to.

6. DEVELOPING A PORTFOLIO RISK SCOREARD

Whilst it is possible to build predictive models of portfolio tracking error, they only use a limited number of the factors associated with risk and the results suggest they are not stable through time; different combinations of factors work best at different times. If a fully specified, robust econometric model cannot be developed, are there less exacting ways of interpreting the results of the study? This section explores the feasibility of creating a scorecard framework that can cover a wide range of factors and which is driven by the linkages observed in the previous sections.

To be useful in practice, a delicate balance has to be struck between ensuring that the factors are quantitatively and theoretically valid, but also ensuring they are intuitively acceptable to practitioners' experience. The system also has to be capable of being recalibrated through time and sufficiently transparent to allow proprietary systems to be added by individual investors.

If successfully developed, such a scorecard would enable a fund's risk profile to be traced dynamically though time as it evolved, as opposed to a static ex ante classification made at inception. This would facilitate the peer group comparison of funds by types of risk and, hence, a structured trade off between prospective return and risk score. An indication of the types of risk that a fund is taking may also help the style classification of funds.

However, it is not the function of this study to develop and argue for a particular method to be adopted by the property investment industry. Largely, this is because it was the standardised similarity of risk measurement techniques that contributed to the recent crisis. All the lookouts were looking in the same direction.

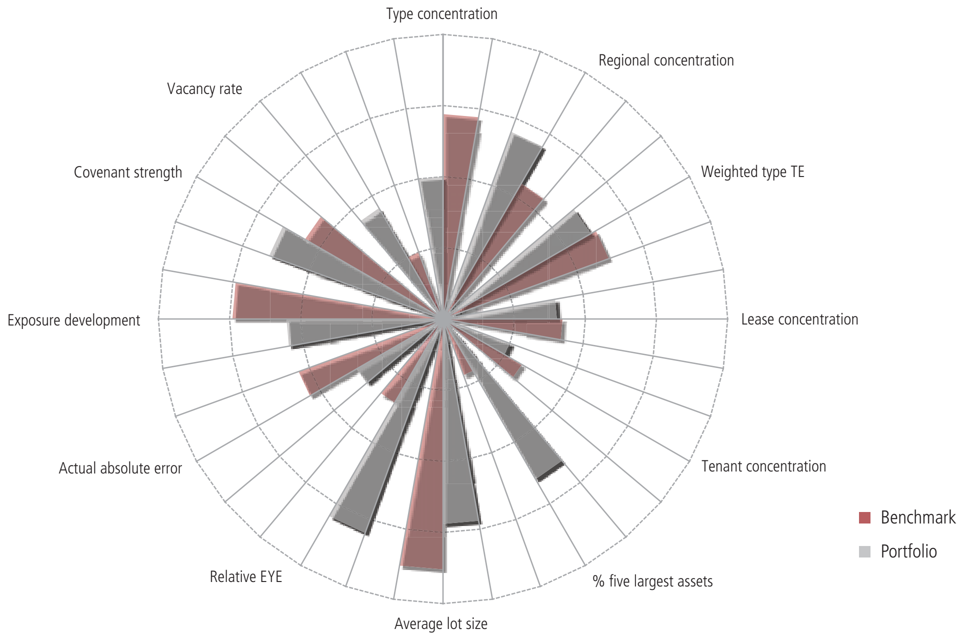
Therefore, what follows are three examples of how individual factor scores might be assembled. They are illustrations, not recommendations.

Finally, it should be emphasized that users should regard the overall score as an auxiliary tool: it is the pattern of the individual factors that carry the real information about the nature of the risks embedded in a portfolio, which, in turn, reveal the portfolio's investment style.

Any scorecard method needs to ensure the constituent factors do not overlap too much, so as to minimise double counting. This is why a number of factors significantly correlated with TR in their own right were removed after it was found they were too closely associated with other factors in the scorecard. Having arrived at a final selection of ingredients, the scorecard compiler needs to re-express the diversity of measures in a common unit of account, a score for each factor. In the process of doing the work it was noted that some factors do not represent a risk at all below certain levels. Leverage, for example, hardly seems to matter in terms of increased risk below LTVs of 20%; and, indeed, below 0% (net cash) would damp other risks in the portfolio.

The approach adopted here was to score all the factors in section 3 on a three-fold basis: low, medium and high, scoring 0 for low, 2 for medium and 5 for high. These scores were selected by trial and error, looking at how past scores correlated with subsequent portfolio risk (TR1). "Low" was defined as the portfolio falling in the least risky quartile of the factor in question; "medium" the middle two quartiles and "high" 5 for the most risky one. Figure 6 shows the four quartiles as concentric bands around the centre of the Risk Web. Each ray shows a factor score for the portfolio (in red) and its benchmark (in grey). The longer the ray, the greater the value of the factor. Taken together, the rays show the style profile of the portfolio relative to its benchmark.

Figure 6: Risk Web 2.0



It should be noted that the interquartile boundaries, shown in Figure 6 and used by all three weighting methods set out here, will steadily vary through time as the IPD Universe evolves, and so may require updating from time to time. However, managers with a reasonable number of properties could develop their own estimates of the boundaries, should they wish to implement their own version of these scoring systems. They could do this by generating simulated portfolios and scoring them along with the actual portfolios under their management.

Table 15 shows three illustrative ways of combining the risk factors into an overall score. In each case, the resulting total of the 12 factor scores is then multiplied by the LTV of the portfolio, so if LTV was 50% the score was doubled and if it was -50% (half cash) the score would be halved. Since all of the factors that proved significant with leveraged returns were either highly correlated with, or were also present in, the dozen factors from the unleveraged analysis, they were not included in the scorecard so as to avoid double counting.

Finally, the issue of weighting has to be addressed. There is a case for not weighting the factors at all, as was the approach used by Risk Web 1.0, and one of the methods in Table 15 is, indeed, unweighted. However, this study has shown that some factors are stronger than others; moreover, some sources of risk may be of greater or lesser importance to particular investors. In either of these cases, it is logical to weight some factors more highly than others. This can be done either on a subjective basis or more quantitatively, as in the examples shown here.

Two approaches have been developed here. In addition to the unweighted version, one set of weights is generated by fitting all the factors into a regression and estimating the sensitivity of TR1 to each factor. The weights are then calculated in proportion to the factor's sensitivity. The second is by generating weights that reflect the frequency with which the factor has been significantly related to subsequent risk in the period studied.

On the left hand side of Table 15 are the selected factors, followed by their inter quartile values, dividing their dispersions into three parts. If users believe the market is going to rise the cyclical factors might be dispensed with, as they only kick in on the downside.

The illustrative portfolio's score is then shown with an array of 0s, 2s, and 5s, This portfolio would probably be a specialist fund, well spread geographically but with some large assets in it. It does not have development at present but has a relatively high vacancy rate, which would be a risk in a declining market. The use of 0, 2 and 5 as scores to represent the portfolio's position was arrived at by back-testing the sampled portfolio scores over the study period. In 10 out of the 11, the results, calculated by summing the factor scores on an unweighted basis, corresponded to the portfolio average TR1 by each quartile, so a high risk score corresponded to a top quartile TR1 and so on (see Figure 6).

On an unweighted basis, the portfolio has a risk score of 25 in the table, with the expectation that general market values will fall over the next one to two years. Given that the minimum score is zero and the maximum 60 (12 times five), a score of 25 is slightly below average. However, the portfolio has an LTV of 45% which raises the risk score to, coincidently, 45. If the user expects values to trend upwards in real terms, then the cyclical factors may be discounted as they only kick in on the downside.

The second and third approaches tested two weighting systems. One approach is to weight the factor scores by the number of years in which the factors are significantly linked to subsequent risk. For convenience, these weights are adjusted proportionately so that they sum to one. Factoring the weights against the score and then summing them produces a score of 2.2 in a range from zero to five, again slightly below average. Applying 45% leverage increases risk to a score of just over four.

The third approach is shown on the right hand side of Table 15. Here, the weights are produced by forcing the 12 factors into a regression purporting to explain TR1 in 2008. The weight is then derived by calculating the contribution each factor makes to the estimated value of risk, using average values for all the factors. These are then re-expressed as weights, proportions of one in the table. Despite the complexity of this approach, it comes up with a very similar answer to the weights based on frequency approach.

Readers interested in investigating this further can access the IPF website, where they will find Table 15 set up as a spreadsheet and where the effect on the score of varying the LTV ratio and the factor scores themselves can be tested.

There is a whole range of ways in which multiple scores can be reduced to one overall score and, based on the unweighted model in Table 15, IPD is considering developing a new version of the original Blundell risk web that has appeared in its reports since 2003. An illustration of what it will look like is shown in Figure 6. There are 12 spokes, corresponding to the 12 risk factors. In each case, the portfolio is shown in the grey tone and the universe/benchmark average is red. The length of each ray in the web corresponds to the relative score of the portfolio.

Table 15: Three illustrative scorecards

	Interquartile ranges			Unweighted score				Weights based on frequency	Weighted score	OLS based weights				Weighted score
Portfolio factor	Bottom	Medium	Top	Qtile:	4th	2nd 3rd qile	1st							
Evergreen										Coeff	Mean val	Elasticity	Weight	
Property type concentration	0.06	0.1	0.29				5	0.12	0.6	3.11	0.25	0.015	0.06	0.29
Regional concentration	0.04	0.07	0.14		0			0.12	0	1.77	0.15	0.005	0.02	0.00
Weighted tracking error of type	4.06	4.3	4.6			2		0.04	0.08	0.39	4.400	0.034	0.13	0.26
Lease end concentration	0.04	0.07	0.18		0			0.11	0	3.55	0.14	0.010	0.04	0.00
Five largest assets % value	31.87	39.75	60.1				5	0.12	0.6	0.03	47.4	0.028	0.11	0.54
Average lot size £m	4.1	6.4	14.9			2		0.08	0.16	1.27	2.1	0.052	0.20	0.40
Top 10 tenants % ERV	23.6	33.5	48.1		0			0.09	0	0.01	37.4	0.007	0.03	0.00
Relative equivalent yield	0.94	1	1.05			2		0.04	0.08	4.68	1	0.092	0.35	0.70
Previous TR	1.94	3.95	7.27			2		0.11	0.22	0.12	3.1	0.007	0.03	0.06
Cyclical									0					
Development	0	0	1.08		0			0.04	0	0.08	2	0.003	0.01	0.00
Relative covenant strength	3.1	-1.15	-5.8			2		0.06	0.12	0.02	1.58	0.001	0.00	0.00
Vacancy rate	3.2	5.4	9.1				5	0.07	0.35	0.05	6.5	0.006	0.02	0.12
	Minimum					0			0			0.261	1.00	0.00
	UNLEVERAGED FACTOR TOTAL					**25**		1	**2.2**					**2.4**
	Maximum					60			5					5
	LTV (%)			45										
	LEVERAGED TOTAL					**45**			**4.0**					**4.3**

7. CONCLUSIONS AND FINAL THOUGHTS

The study had three main aims: to validate the findings of the original risk web work in the light of additional data since 2003, to test whether quantitative models of portfolio risk could be developed, and to identify factors that were consistently associated with subsequent risk.

7.1 Do linkages exist?

The work has confirmed that the 2003 Risk Web was on the right track but not all of the factors in it are related to risk all of the time. Additionally, some of them were heavily intercorrelated, so effectively double counting their effect. However, some 13 factors were identified that did appear to exercise a statistical influence over portfolio risk, with levels of correlation that were far superior to that of prior portfolio volatility, a frequently used measure of risk.

Over the 11-year period (1999 to 2009), risk to directly held assets was consistently associated with concentration factors such as lot size, property type, regional exposure and lease termination. Portfolios with relatively high concentrations of value in these areas tended to exhibit higher differences (positive and negative) in subsequent years. These factors (termed evergreen) were complemented by three factors, which only seem to exercise an effect on the downside after periods when real values have been falling (termed cyclical). The cyclical factors are exposure to development, covenant strength and vacancy rate, making 12 in all plus leverage.

However, the factors never "explained" much more than 50% of the subsequent differences in portfolio returns, and, also, the factors in the regression models developed varied from year to year. These facts combine to prevent the existence of a "silver bullet"; this would have been an unrealistic expectation of the study as, if there was one, it is almost certain portfolio managers would have found it already.

The high preponderance of unexplained risk suggests that variance in returns is coming from sources not analysed, possibly manager behavior or from inappropriate classifications of property. Arguably, sector and region are not the best ways of differentiating between different types of properties, a possibility highlighted by Guy Morrell in the 1990s.

The unexplained risk, therefore, has negative implications for the top down approach to strategy; while random "noise" in the results was reduced by taking a two- or three-year time horizon, some is likely still to remain. If this is so, then it is the property specific details that matter, arguing strongly for an approach to risk management that is based, in part at least, on bottom up factors, and not entirely upon the conventional top down classes into which the IPD Universe is segmented.

Also worthy of note was the failure of a number of factors to prove significant save in isolated years. These were mainly in the tenant related fields and factors based on volatility. The income-related factors may well exercise a longer term influence on value and so appear as noise in the relatively short term relationships developed here, hence the recommendation that further work might be done on these factors (see section 7.6 below). The failure of many of the variance-based factors was surprising, only one made it into the final selection. Arguably, if past performance is no guide to the future, then it should not come as a surprise if the volatility of that performance is not much help. However, this is not to say that variance measures are of no use at the market level.

7.2 The impact of leverage

Portfolio risk measured in terms of return divergence had been steadily increasing from 1999, then surged upwards in 2008 to 2009. This probably reflected rising vacancy rates but, also, the increased use of leverage in the UK investment market. In a +50 sample of open- and closed-ended portfolios, average portfolio loan to value ratios rose from just under 11% at end 2002 to over 24% by end 2008 and average dispersion in the sample nearly tripled. The effect was also seen, albeit to a much lesser extent, in the unlevered direct asset portfolios, suggesting the effect of leverage may be transmitted by the comparables based valuation process beyond the portfolios using debt.

Because it alters returns, leverage effectively masks the fundamental relationships observed in the direct portfolios. The number of significant factors is very much reduced, with a couple of new factors being introduced. It was concluded that, while leverage (or net cash) must be taken into account as a factor where it exists, the underlying fundamental factors should not be discarded. The degree of leverage in a portfolio can reduce rapidly and so risk factors, whose effects were masked, will then come back into play. In sum, leverage amplifies risks and at the same time masks the impact of underlying direct factors.

The ability of leverage to mask the influence of other factors may explain how the effects of the initial sub-prime collapse propagated across ostensibly diverse assets. If they were geared they were all subject to the same forces. This may explain the rise in the correlation in the returns to individual properties that Paul Mitchell has reported took place over the study period.

7.3 Income factors

In the main, the focus of the study was on the causes of differences in total returns. However, some time was spent on repeating the various analyses on components of total return. While capital and total returns are largely driven by the same factors, analysis of income returns revealed some interesting differences. While also related to concentration factors, income factors were more linked to covenant and lease length in 2008, when values were under pressure, but not in 2004, when values were rising rapidly. It was found that income returns were generally more closely linked than capital returns when values were falling, with the reverse being true when values were rising. However, income per se is only a small proportion of differences in total returns, so the focus remained on total return. This may be a fruitful area for further research, as it is possible that income risk factors' influence may take effect over longer periods than those covered by this study, which searched for the existence of relationships one, two and three years forward from the date of the portfolio factors.

7.4 Time horizon

In the case of direct assets, the strength of the linkages improved as the time horizon lengthened. This suggests that there is some "noise" in the one-year results generated by one off random factors influencing portfolio value, as the same effect was not seen with income returns. Leveraged results did not improve as much as a longer time horizon was taken. The impact of leverage is strong and immediate. The conclusion to be drawn is that the process of estimating the balance of risks in a portfolio is one that should be done regularly. Even if the portfolio is not subject to much change, the relationships are only good for a couple of years and the cyclical factors are likely to alter as market conditions change.

In most cases the risk analysis would be best integrated in the portfolio's strategic review, which usually happens on an annual basis. The scorecards and the risk web itself could readily be used as a monitoring tool to review the impact of major sales or purchases.

7.5 Modelling risk

Several attempts were made to develop predictive models of portfolio risk, with varying degrees of success. Generally, models of the PPFI leverage portfolios were more successful, with leverage being the dominant variable in the analysis. Both leveraged and direct asset samples showed interesting and quite good measures of explanation, especially in the 2002 to 2006 period. The quality of statistical "fit" began to peter out in the last couple of years.

Notwithstanding some reasonable results for leveraged portfolios, the residual error in the models would prohibit strategy being solely based on them. In addition, as the key variables vary through time, such a mechanistic approach could lead to quite misleading results.

Instead, a more informal approach has been outlined, using the basic risk web approach updated to include the variables identified by the study plus several scoring systems, to illustrate how an overall risk rating could be achieved.

While there may be no silver bullet, it is possible to envisage circumstances in which the risk factors could combine to create a "perfect storm". The study has found concentration factors matter most of the time and has tried to draw out their individual contributions to subsequent risk.

Suppose two or more factors were to combine? For example, what if a leveraged portfolio faced a concentration in its refinancing dates that combined with a concentration of leases coming to an end? Or if a batch of developments were slated to come to market at about the time a portfolio's key tenants' covenants were down-graded? This study does not model such events but it does provide risk managers with the key variables to include in their own stress testing of the impact on portfolio returns. It is important to emphasise "their own". Managers should own their process of risk management and, while methods of using the findings of this study have been illustrated, managers should develop processes suited to their particular needs.

7.6 Further research

This study has focussed on risk expressed in terms of a portfolio's likely future difference from the market average. However, the results suggest that the behaviour of this average variance is, in itself, subject to considerable variation and may well reflect market wide factors, such as the application of leverage and the level of vacancy. The evidence available to this study is too short but research into what causes average variance to vary might provide complementary insights into the general level of risk in the market. Data on portfolio variance and factors such as vacancy rate go back a lot earlier than 1999, the start of the data in this study. The output from such a study could lead to a general indicator of property market risk, analogous to the VIX index for US equities.

Another avenue, touched upon in the study, is the differences between the factors linked with capital and income. Income represents the bulk of property's long term returns. So factors affecting income should be of relatively more importance to long term investors, some of whom are relatively unconcerned by year on year vagaries in capital returns. The problem with this kind of analysis is the turnover of properties in portfolios. Long term analysis of income risk would require analysis of groups of properties, which have been held in a constant state for a number of years, perhaps being put into dummy portfolios to filter out stock specific effects.

7.7 Final thoughts

What does this study tell us that we didn't know before? First, we now know there is an alternative approach to dealing with risk than the retrospective, non-diagnostic study of past return volatility. The study has identified a set of factors that both practical experience and statistical tests appear to influence future risk in portfolios, and that offer managers tangible levers with which to manage at least a portion of the risk facing them. Subsequent work will improve on what has been done here, perhaps with the benefit of a few more years' data.

Second, the critical role of leverage. This has emerged as a feature of markets over the past decade and it is here to stay. The importance of leverage as such was not so much of a surprise as this is well documented; rather, it is the way it drowns out the other factors by changing portfolio returns. While they retain a latent influence, waiting to be seen when the volume of leverage is turned down, any risk mitigation they offer is masked while leverage is in place.

It is hoped that the analyses reported here will stimulate thinking about risk in property and throw up new lines of analysis that the authors have not envisaged. For too long, risk in property has been in thrall to conventional capital market theory; it is time property developed approaches more suited to its intrinsic characteristics as a distinct actively managed asset class.

Risk factor definitions:

1. **Property Type Concentration (proptypeconcentration):** expressed as the sum of the squared differences between the fund and the Index weights by IPD Digest Property Types.

$$Index = \sum_{Type=1}^{Type=11} (Wfund_{Type_i} - WUniverse_{Type_i})^2$$

Property types
Std Shop
Shopping Centre
Retail Warehouse
Dept / Variety Store
Supermarket
Other Retail
Std Office
Office Park
Std Industrial
Distribution Warehouse
Other

2. **Regional Concentration (locationconcentration):** expressed as the sum of the squared differences between the fund and the Index weights by IPD Regions.

$$Index = \sum_{Region=1}^{Region=16} (Wfund_{Region_i} - WUniverse_{Region_i})^2$$

Regions
City
Mid-town
West End
Inner London
Outer London
South East
South West
Eastern
East Midlands
West Midlands
Yorks & Humber
North West
North East
Scotland
Wales
Northern Ireland

APPENDIX

3. **PAS Segment Concentration (segmentconcentration):** expressed as the sum of the squared differences between the fund and the Index weights by IPD PAS Segments.

$$Index = \sum_{PAS=1}^{PAS=11} (Wfund_{PAS_i} - WUniverse_{PAS_i})^2$$

PAS Segments
Std Retail South East
Standard Retail Rest UK
Shopping Centre
Retail Warehouse
Office City
Office West End & Mid Town
Office Rest South East
Office Rest UK
Industrial South Eastern
Industrial Rest UK
Other

4. **Weighted Property Type Tracking Error (proptypetracking):** Weighted Tracking Error (1981–2009) by IPD Digest Property Type.

$$WeightedTE = \sum_{Type=1}^{Type=11} (Weightfund_{Type_i} * TE_{Type_i})$$

5. **Weighted Regional Tracking Error (regiontracking):** Weighted Tracking Error (1981–2009) by IPD region.

$$WeightedTE = \sum_{\mathrm{Re}\,gion=1}^{\mathrm{Re}\,gion=16} (Weightfund_{\mathrm{Re}\,gion_i} * TE_{\mathrm{Re}\,gion_i})$$

6. **Weighted PAS Segment Tracking Error (tracksegment):** Weighted Tracking Error (1981–2009) by IPD PAS Segments.

$$WeightedTE = \sum_{PAS=1}^{PAS=11} (Weightfund_{PAS_i} * TE_{PAS_i})$$

7. **Weighted Property Type CAPM Beta (proptypebeta):** Weighted CAPM Beta (1981–2009) by IPD Digest Property Type.

$$Weighted\beta = \sum_{Type=1}^{Type=11} (Weightfund_{Type_i} * \beta_{Type_i})$$

8. **Weighted Regional CAPM Beta (regionbeta):** Weighted CAPM Beta (1981–2009) by IPD Region.

$$Weighted\beta = \sum_{Region=1}^{Region=16} (Weightfund_{Region_i} * \beta_{Region_i})$$

9. **Weighted PAS Segment CAPM Beta (weightedbeta):** Weighted CAPM Beta (1981–2009) by IPD PAS Segments.

$$Weighted\beta = \sum_{PAS=1}^{PAS=11} (Weightfund_{PAS_i} * \beta_{PAS_i})$$

10. **Weighted Property Type Volatility (proptypevolatility):** Weighted Volatility (1981–2009) by IPD Digest Property Type.

$$WeightedVolatility = \sum_{Type=1}^{Type=11} (Weightfund_{Type_i} * Volatility_{Type_i})$$

11. **Weighted Regional Volatility (regionvolat):** Weighted Volatility (1981–2009) by IPD Region.

$$WeightedVolatility = \sum_{Region=1}^{Region=16} (Weightfund_{Region_i} * Volatility_{Region_i})$$

12. **Weighted PAS Segment Volatility (volatsegment):** Weighted Volatility (1981–2009) by IPD PAS Segments.

$$WeightedVolatility = \sum_{PAS=1}^{PAS=11} (Weightfund_{PAS_i} * Volatility_{PAS_i})$$

13. **Top five assets (top5assets):** five largest assets as a % of fund CV.

14. **Large assets (bigassets):** % of fund CV in +£100m properties.

15. **Number of assets (numberassets):** number of assets flagged as held property and with a CV over £10,000.

16. **Average lot size (lotsize):** average size of the fund’s assets.

17. **Development Exposure (development):** fund CV invested in assets flagged as development in the IPD databank as % of fund's CV.

18. **Land Exposure (land):** fund CV invested in assets flagged as undeveloped land in the IPD databank as % of fund's CV.

19. **Turnover Ratio (turnover):** fund turnover as a % of fund's CV. Defined as the sum of the capital expenditure and the absolute value of the capital receipts divided by the fund's CV.

$$Turnover = \frac{Capex + |Caprec|}{CV}$$

20. **Net Investment Ratio (netinv):** fund net investment as a % of Fund's CV. Defined as the difference between purchases and sales divided by the fund's CV.

$$Turnover = \frac{Purchases - Sales}{CV}$$

21. **Reversionary Potential (revpot):** defined as the fund rent passing divided by fund total ERV.

$$\mathrm{Re}\,versionaryPotential = \frac{\mathrm{Re}\,ntPas\sin g}{ERV} * 100$$

22. **Relative Covenant Strength (covstrength):** IRIS property (ERV weighted by tenant) scores weighted by CV to obtain fund's overall covenant score minus the overall covenant score of the universe sample.

23. **Covenant Strength–Reversionary Potential Score (scorerevpot):** defined as the Relative Covenant Strength of the fund times its reversionary potential.

$$Score = RCS * \frac{\mathrm{Re}\,versionaryPotential}{100}$$

24. **Risky Covenants (covrisk): % of fund CV in properties (ERV weighted by tenant):** scoring maximum, high and medium high risk (D&B score <=50).

25. **Alternative Risky Covenants Definition (covrisknew):** % of fund CV in properties (ERV weighted by tenant) scoring maximum and high risk (D&B score <=35).

26. **Tenant Concentration (tenantconc):** % of fund rental value occupied by 10 largest tenants.

27. **Mean Unexpired Lease Length (meanlength):** fund's average remaining lease lengths weighted by asset CV. Asset average unexpired lease length calculated using ERV weighted unexpired lease length of the tenancies.

28. **Alternative Risky covenants–Reversionary Potential Score (riskycovrevpot):** defined as % of fund CV in properties (ERV weighted by tenant) scoring maximum and high risk (D&B score <=35) times its reversionary potential.

$$Score = Risky\,covenant * \frac{ReversionaryPotential}{100}$$

29. **Alternative Risky Covenants–Long Lease Score (risklonglease):** defined as % of fund CV in properties (ERV weighted by tenant) scoring maximum and high risk (D&B score <=35) times the % of fund CV invested in assets with an unexpired lease length greater than 10 years.

$$Score = Risky\,covenant * Longlease$$

30. **Short Lease Exposure (shortlease):** defined as the % of fund CV invested in assets with an unexpired lease length under five years (including vacants).

31. **Lease Termination Concentration (leaseconcentration):** expressed as the sum of the squared differences between the fund and the Index weights by IPD Unexpired Lease Length bandings.

$$Index = \sum_{BAND=1}^{i=5} (Wfund_{BAND_i} - WUniverse_{BAND_i})^2$$

Bandings
0-5 years
6-10 years
11-15 years
16-20 years
20+ years

32. **Weighted Unexpired Lease Length Tracking Error (tracklength):** Weighted Tracking Error (1998–2009) by IPD Unexpired Lease Length bandings.

$$WeightedTE = \sum_{Band=1}^{Band=5} (Weightfund_{Band_i} * TE_{Band_i})$$

33. **Weighted Unexpired Lease Length CAPM Beta (weightedlease):** Weighted CAPM Beta (1998–2009) by IPD Unexpired Lease Length bandings.

$$Weighted\beta = \sum_{Band=1}^{Band=5} (Weightfund_{Band_i} * \beta_{Band_i})$$

34. **Weighted Unexpired Lease Length Volatility (tracklength):** Weighted Volatility (1998–2009) by IPD Unexpired Lease Length Bandings.

$$WeightedVolatility = \sum_{Band=1}^{Band=5} (Weightfund_{Band_i} * Volatility_{Band_i})$$

35. **Vacancy Rate (vacancy):** vacant ERV as % of fund ERV.

36. **Relative Equivalent Yield (EYE):** the ratio of the fund's EYE divided by the full fund sample average EYE.

37. **Capital Growth Ratio (cgratio):** defined as the % of the absolute value of the total return components driven by the absolute value of the capital growth.

$$CGRatio = \frac{|CG|}{|IR| + |CG|}$$

38. **Exposure to central London (londonweight):** % of fund CV invested in central London.

39. **Capital Expenditure (capex):** % of fund CV defined as capital expenditure (includes both purchases and sales).

40. **Capital Receipt (caprec):** % of fund CV defined as capital receipt.

41. **Non Direct Investment (indirect):** % of NON DIRECT investments in fund's CV invested in UK.

42. **Absolute Relative TR Error:** the absolute difference of the fund's direct TR minus the full fund sample average TR.

43. **Net Leverage:** net borrowings as a % of GAV (AREF funds only).

$$NetLeverage = \frac{Debt - Cash}{GAV}$$

Printed on recycled paper

Investment Property Forum
New Broad Street House
35 New Broad Street
London EC2M 1NH

Telephone: 020 7194 7920
Fax: 020 7194 7921
Email: ipfoffice@ipf.org.uk
Web: www.ipf.org.uk