How many leases are enough to diversify a portfolio of multi-let industrial properties?

Brett L Robinson

Seven Dials Fund Management
19 Short's Gardens
London WC2H 9AW

Phone: 020 7240 8008, Email: brett.robinson@7dials.com

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Abstract

In modern finance, portfolio diversification is analysed by considering the interaction of the individual portfolio assets: the variances and correlations of the individual asset returns are of central importance. Within parts of the industrial property sector however, diversification is often referred to with a different emphasis. For multi-let properties, investors and lenders are often particularly concerned with the variability of the overall portfolio income and the possibility and extent of shortfalls in income through voids and tenant defaults. In this context, the variability of asset performance (total return) is inadequate in isolation for the analysis of investment risk. With multi-let properties, one of the primary goals of diversification is to reduce the risk of income shortfall. But how many leases is enough to give an acceptable level of risk of income shortfall? This paper attempts to answer that question through the use of simulation techniques. Potential income shortfall is a crucial consideration in lending decisions as the interest cover ratio is a key loan covenant. This makes the question of how many leases is enough to diversify a portfolio of multi-let industrial properties an important one for borrowers and lenders.

Keywords: Diversification, Multi-let, Simulation

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Introduction

Property fund managers often cite the benefits of diversification in the marketing of their funds. Fund documentation will typically refer to the spreading of investment risk by means of, for example, ensuring a spread of geographic locations and building types and limiting the value of a single asset as a proportion of the whole portfolio. Whether these types of strategies are sufficient to achieve a significant level of diversification is a moot point as the academic literature suggests that the number of assets required is required is much larger than is held by most institutional portfolios (Brown 1988, 1991, Cullen 1991, Byrne and Lee 2001, Callender et al 2007).

Using the techniques of modern finance, the diversification referred to in the preceding paragraph would normally be analysed by considering the performance and interaction of the individual portfolio assets. The variances and correlations of the individual asset returns are of central importance. Within parts of the industrial property sector, however, diversification is often referred to with a different emphasis. The industrial sector is broken down into two main sub-sectors: distribution warehouses, typically let to a single tenant, and multi-let industrial buildings. For multi-let properties, investors and lenders are often particularly concerned with the variability of the overall portfolio income and the possibility and extent of shortfalls in income through, for example, voids and tenant defaults. In this context, the asset performance (total return) is inadequate in isolation for the analysis of investment risk. With multi-let properties, one of the primary goals of diversification is to reduce the risk of income shortfall.

The risk of income shortfall is important to both equity investors and debt providers. The decision whether to lend money against the security of an office building let to a single tenant on a long lease will crucially depend upon the assessment of the creditworthiness of the tenant. Similarly, lending against a portfolio of single let, long lease assets will require credit assessment of the portfolio's tenants. With a multi-let industrial portfolio lease lengths will be much shorter and therefore some voids will occur in the normal course of events when leases expire and tenants leave. In addition, some of the tenants are likely to fail, at least occasionally, and so become unable to meet their obligations to pay the rent. Hence the decision to invest in or lend to a portfolio of multi-let properties will rely upon some assessment of the distribution of future income from the portfolio and, for a potential debt provider in particular, an assessment of the likelihood of the income being sufficient to service the debt.

An investor in or lender to a portfolio of multi-let assets must consider not only the probability of tenant default but also the probabilities of being able to re-let space at expiry and the time to re-let, the costs of these activities and so on. The promoter of a fund investing in such assets will usually refer to the benefits of diversification in reducing the risk of experiencing a shortfall in portfolio income and thus the ability to make interest payments and generate income distributions for investors. Diversification comes from not only having many assets but more fundamentally, from having many different leases. But how many leases is enough to give an acceptable level of risk of income shortfall? This paper attempts to answer that question.

The rest of the paper is structured as follows. The next section is a literature review. There then follows an explanation of the methodology to be used and the data used in the numerical analysis. The third section presents the results of the analysis. The fourth and final section provides a summary and conclusions, including suggestions for further work.

Literature review

In conventional finance theory risk is interpreted as the variability of returns, usually measured by the variance or the standard deviation (Markowitz 1952). In the Markowitz model the variability of expected portfolio returns is reduced as the number of assets increases and the specific risk within the portfolio is reduced. Under certain assumptions and with full knowledge of the covariance structure of returns it is possible to select the lowest risk portfolio for any given feasible expected return. Early empirical work in this field (Evans and Archer 1968) investigated how many stocks were required to diversify a portfolio and found that portfolio risk fell away quickly as the number of stocks increased initially but the marginal benefits of adding further stocks diminished rapidly.

The single index model (Sharpe 1963) introduces the idea of analysing the behaviour of a single stock in relation to the market. Under the capital asset pricing model (Sharpe 1964) the specific or diversifiable risk of a stock is not rewarded as it can be diversified away and only the exposure of a stock or portfolio to the market or un-diversifiable risk is rewarded.

The extensive literature that has followed these early foundations has extended and deepened our understanding of risk but the key concepts of diversification and market risk remain central to our thinking. In the real estate literature, much work has attempted to apply the models from mainstream finance but the particular characteristics of real estate, especially its heterogeneity and lumpiness, have led to a growing body of work that addresses issues unique to the asset class.

Portfolio size is an important consideration in the construction of a real estate portfolio because the indivisibility of real estate assets means that holding large numbers of assets requires large amounts of capital. Brown (1988) showed that most of the possible risk reduction was achieved with relatively small numbers of properties as the marginal decrease in risk diminished rapidly after 10 properties. Other papers produced broadly similar results. Jones Lang Wootton (JLW) (1986) argued that nearly all the possible reduction in risk had been achieved after 20 properties. Barber (1991) found that the majority of diversification was achieved once 40-45 properties were held in a portfolio.

These results show that high levels of reduction in the variability of portfolio returns are possible with relatively modest numbers of properties. However, these findings are based on averaging the results across many portfolios and any particular portfolio may have a much higher level of risk. Tole (1982) makes this point with regard to portfolios of securities and Byrne and Lee (1999) point out the risks in relying on results based on averages for property portfolios where the averaged results may hide a large amount of variability within the data.

The early work on risk reduction generally analysed the impact of portfolio size by assuming equally weighted portfolios of properties. However, it has been acknowledged that the impact of value-weighting will reduce the risk reduction achievable (Brown 1991, Morell 1993, Schuck and Brown 1997) as value-weighting leads to higher specific risk and so higher total risk within the portfolio.

Furthermore, reducing the variability of portfolio returns does not necessarily equate to a high degree of diversification in the sense of the market explaining a high degree of the variability in the returns of the portfolio. For example, Brown (1988) found that 200 properties would be required in order for the market to explain in excess of 95% of the portfolio's variation returns. Low correlation between assets allowed rapid risk reduction but because the market accounted for only a small part of the return for each individual asset only very large portfolios could hope to achieve high degrees of diversification. Similarly, Cullen (1991) and Byrne and Lee (2001) concluded that four to five hundred would be needed to achieve a satisfactory level of diversification. In a similar vein, Devaney and Lee (2005) study the benefits of increasing the number of properties held and demonstrate that downside risk is diminished as portfolio size increases. Callender at al. (2007) confirmed the earlier results in this area finding that 30-50 properties were enough to achieve a high level of risk reduction but full diversification required very large portfolios.

Other work has sought explanations as to the relatively small numbers of assets held by investors in contrast to the implications of these findings. Lee (2005) follows the approach of Statman (1987) and finds that investors are probably rational to hold small portfolios because the marginal benefits of diversification are so small.

Whatever the portfolio size, it may be that different methods of portfolio construction offer more efficient diversification strategies. Thus it is of direct practical importance whether it is better to diversify by means of geography, sector, segment or some other means. Devaney and Lizieri (2005) find that sector and geography are at best weak explanatory factors for the distribution of returns. Baum (2006) argues that large capital values in some segments such as shopping centres make it impossible for all but the very largest investors to diversify specific risk in these segments down to an acceptable level.

More recent work by Mitchell (2012) suggests that most properties behave like the market most of the time and that impending lease events are the single most important source of stock specific risk.

The approach taken in this paper to assess risk is to consider the potential shortfall in portfolio income over an assumed investment horizon. Variability in portfolio return is important but in many circumstances it is portfolio income that is critical. Investors often have income targets even if the portfolio is ungeared. For example, actuarial valuation of pension funds will be based upon projected portfolio income and investors in open ended funds will be anticipating a particular level of income. For geared portfolios the expected portfolio income is even more important as the lender will normally specific an interest cover ratio as one of the loan covenants.

This study considers risk at a more detailed level than that of variability of total return, considering only the variability in the income component of return. Whilst historical data could be investigated it would be very difficult to disentangle the effects of many variables. By using simulation techniques it is possible to isolate the impact of specific variables of interest such as void period, rent free and lease length for new lettings.

Simulation techniques have been used to examine the option characteristics of leases such as upward only rent reviews as discussed in Booth and Walsh (2001). Break clauses, turnover rents, renewal options and flexi-leases are all examples of features that provide either the tenant or landlord with some sort of option. Work done to investigate the pricing of leases incorporating such features has also encompassed the pricing of short leases because the cashflows from holding a property with a short lease require a similar type of analysis and the analytical tools and techniques are common (McAllister 2001).

Whilst the study in this paper is specifically of multi-let industrial property, the market wide shortening of lease length means that the issues of pricing short-lease assets and analysing their risk is likely to become increasingly important.
Crosby et al. (1998) investigated the incidence of new forms of lease structure and found limited incidence of new structures but strong evidence of shortening lease

length. Lizieri (1997) documents similar changes in the market for business space and also raises questions about the impact of alternative lease structures on the pricing of commercial property, noting that valuation methods adopted in the UK are ill-suited to valuing non-standard type of leases.

In addition to the shortening of leases, the UK market has seen a marked increase in the number of leases with tenant break options, a feature that emerged in force in the weak market for space in the early 1990s. McAllister and O'Roarty (1998) discuss the factors at work when a tenant is faced with a decision over whether to exercise a break and highlighted the "complex range of factors", making any numerical analysis challenging, not least from a data perspective. In later papers (McAllister and O'Roarty 1999, McAllister 2001) the authors examine the use of simulation techniques to value leases with break clauses.

The common approach to valuation of a lease with some option-like features is to use a comparable 'standard' lease for which the price is known and find the starting rent on the flexible lease contract that gives the same present value as the standard lease (Baum 2003 and Ward et al. 1998). Alternatively the reduction in value can be estimated. Baum (op. cit.) goes further by extracting the implicit growth rate embedded in the valuation of the standard lease and raises the question of whether the valuation accounts for the future volatility of the rental growth.

The approach in this paper differs from the existing simulation based research into short leases by focusing not on the valuation of the leases, which is taken as given based on some assumed level of market pricing, but on the variability of the cashflows resulting from those leases. Market efficiency, assuming it exists in the UK property market, may protect the naive purchaser from mis-priced acquisitions but the risks to the cashflows flowing from the asset, no matter that they are correctly priced, may still be unwelcome if not properly understood by the purchaser.

Methodology and data assumptions

The sort of multi-let assets that we wish to analyse typically have a mixture of short to medium term leases. Gerald Eve (2011) provides a useful source of information as to the characteristics of the UK multi-let industrial property market. For the smallest units (less than 5,000 sq ft) the weighted average unexpired term (assuming all breaks are exercised) was 2.4 years and was 2.6 years for the next size band of 5,000 – 10,000 sq ft. For the largest units in the sample, those over 50,000 sq ft, the weighted average unexpired term was significantly higher at 6.1 years.

In terms of lease durations on new lettings the largest units had an average of 8.5 years for leases signed in 2009-2010 and an unexpired term of 7.7 years. At the other end of the spectrum, the smallest units had an average 3.9 years on new lettings (2.9 years unexpired term) and the 5,000 – 10,000 cohort had an average of 4.3 years (3.3 years unexpired term).

The focus in this paper is on the smaller size of units; very large units clearly have different lease characteristics to small units and are much less common. As the purpose of the research is an exploration of the diversification potential of increasing the number of short leases in a portfolio it would be of much more limited practical application to focus on portfolios of larger units.

For the base unit of analysis, we will consider an asset with twelve units, let on identical terms save for the terms of the lease. An asset with twelve leases is chosen as this allows a reasonable spread of lease maturities that in aggregate produce an average unexpired term consistent with the data reported in Gerald Eve (op. cit.). The average unexpired term on the asset of twelve units is set at 3.25 years, consisting of one lease with 0.5 years to expiry, one with 1.0 year to expiry etc., up to one unit let on a lease with 6 years to expiry[1]. The average of 3.25 years is 0.75 years higher than that reported in Gerald Eve for the two smallest size bands (2.5 years average) but this is to make allowance for the existence of break options. As reported in IPD (2011) - the Strutt & Parker IPD Lease Events Review - of those leases with break options in 2010 74% (by number) did not exercise the option. Gerald Eve reports a similar figure for 2010, up from 66% in 2009. Gerald Eve also reports that the average lease length for new leases signed in 2009/10 for units of less than 10,000 sq ft was 1.0 years higher than the unexpired term, suggesting an increase in the effective average

[1] See the Appendix for further details.

unexpired term of 0.75 years if existing leases have similar break characteristics to new leases.

Gerald Eve does not provide information on the spread of unexpired terms that make up the average quoted and so the spread of lease terms that make up the twelve unit asset may not be representative of the market. However, as the maturities of the twelve leases are evenly spread it is expected that this will provide a more favourable result than a more concentrated arrangement of maturities. Hence the results will provide a lower bound for the estimate of the number of leases required for adequate diversification.

At the end of a lease, a tenant may vacate or agree a new lease. If the tenant vacates, then the landlord will seek to find a new tenant. The time to find a new tenant will vary and so will the terms at which the new lease is agreed. Additionally, at any point in time an existing tenant may fail, when the landlord will again be faced with the challenge of finding a new tenant.

The analysis that is performed focuses on income shortfall and how an increase in the number of leases in the portfolio affects the distribution of future portfolio income. In this sense increasing diversification is synonymous with an increase in the number of leases in the portfolio. More generally, there are potentially many ways to increase diversification, such as by geographic location or the industry sector of the tenant, but this study focuses solely on the size of the portfolio as measured by the number of leases it contains. A single asset containing twelve units let under separate leases is, for the purposes of this analysis, identical to a portfolio of twelve single let buildings let on the same terms.

The presumption is that a greater level of diversification (a higher number of individual units or leases) will, in general, reduce the probability of income shortfall over the investment horizon or holding period. To analyse how the number of leases affects the diversification achieved, we consider the evolution of the portfolio income over a ten year period. The typical institution holding period may be less than ten years but the prospective income in years six, seven and beyond will be very important for the saleability and value of the asset after, say, five years. Furthermore, a 10 year period allows sufficient time for the impact of the initial distribution of maturities to be dissipated and the longer run averaging to come into effect. The capital value at the end of any planned holding period is also a very important determinant of total return but is not considered directly in this paper. What is of concern is the extent to which the likelihood of a shortfall in income during the holding period reduces as the number of leases in the portfolio increase.

For portfolios of different number of leases we analyse the distribution of portfolio income using Monte Carlo simulation based on a common set of assumptions as to the likelihood of each lease event. It is necessary to use simulation techniques as the number of variables and the nature of their interactions are too complex to allow an analytical solution. The simulations were carried out using R, a language and environment for statistical computing (R Development Core Team 2011).

Owing to the large number of possible variables, some simplification of the problem is required. Initially, we assume that all leases have the same likelihood of renewal and that the correlation of lease events is constant and equal to zero across the portfolio. We also assume that the risk of default is zero. In this way, the number of assets is not important; it is simply the number of leases that matter. Clearly this set of assumptions is unrealistic and there is a risk that over-simplification will undermine the significance of the results but greater complexity can be introduced later.

Each lease is assumed to have an ERV of £20,000 and rental growth is assumed to be zero. If a unit is let, the passing rent is set at £20,000; in other words there are no reversions or over-renting. A rental value of £20,000 is consistent with a unit of size between 5,000 and 7,000 sq ft, assuming rents of £3.00-4.00 psf, typical of today's market outside London and the South East.

Whilst this study is not directly concerned with the capital performance of each multi-let asset it is necessary to make some assumptions about asset valuation in order to carry out the analysis. For example, when comparing two portfolios where one has more leases than the other, the larger portfolio will generate higher levels of income than the smaller portfolio. Our concern must be with the income generation relative to the investment required to purchase the asset and hence we must make some assumptions about capital value.

In difficult market conditions, for example where capital is scarce and the risk premium is high, the prices of multi-let assets with voids in them may reflect only the current income and the potential income from re-letting is valued at close to zero. Assumptions about the relative value of occupied and vacant units will likely have a significant impact on the results. If void and occupied units are priced at the same level, the portfolio with a lower initial void level is likely to perform better. If void units are priced at zero, then the portfolio with a higher initial void level is likely to perform better. The approach taken is to consider each extreme of the pricing spectrum and make two comparisons in each case: one assuming that a void unit is valued at the same amount as an occupied unit and one assuming that the void unit is 'priced for free', in other words has zero value. In this way it is hoped to identify any influence that asset pricing has on results.

Asset are priced using a net initial yield (NIY) of 8.5% and 5.8% acquisition costs. The NIY of 8.5% is taken as an indicative level of current pricing based on market information (Strutt & Parker 2012).

If all of the tenancies are of a similar size, the tenants have the same risk of becoming insolvent and the chances of re-letting are the same then the crucial determinant of the distribution of future portfolio income is the number of leases.

In 2010 Gerald Eve (op. cit.) finds that 67% tenants overall renewed at expiry of their lease, up from 61% in 2009. For smaller units, the proportion was close to 70%. In contrast, IPD (2011) find that only 35% of leases with an expiry in 2010 renewed. Earlier versions of the Strutt & Parker IPD Lease Events Review (IPD 2009) show similar results with some variation year to year and between the sectors. Without more detailed information than that contained in the headline results of the Strutt & Parker IPD Lease Events Review on for example, the average size of unit in the industrial assets in the database, it is not possible to determine the cause of such a difference. Given that the Gerald Eve data is broken down into size bands, we take this source as the primary one and for modelling purposes we assume that for each lease there is 0.6 probability of the existing tenant renewing at expiry.

There are three variables which are critical to the analysis and require assumptions as to their probability distributions:

i) Term of the new lease

ii) Duration of rent free period as a percentage of the new lease length

iii) Duration of void period (if lease is not renewed)

In the absence of further more detailed empirical data, the triangle distribution offers a simple representation for any variable. The triangle distribution is defined by lower and upper bounds and a modal value. The mean value of the distribution is simply the average of the three parameters. The triangle distribution does restrict the possibility of very large values as it is capped by its maximum, which, if set too large, will increase the average value beyond the targeted value.

We have an estimate of the average term of a new lease (between 3 and 4 years) and for this analysis can reasonably restrict the maximum to say, 7 years. In practice some small units may have longer lease lengths but small industrial units by their very nature do not typically attract business operations that require very long term commitments. For the term of a new lease the triangle distribution is used with a minimum of 1 year, a maximum of 7 years and a modal value of 3 years, giving an average of 3.67 years.

For the rent free period, it is necessary to define this in relation to the term of the new lease. Discussions with industrial letting agents tells us that the rent free period is typically of the order of 3 months for a 3 year lease and perhaps 6 months for a 5 year lease, which equate to percentages of 8.3% and 10.0% respectively. Undoubtedly some rent free periods can be longer but the frequency of incentives over 20% is considered to be very low. The rent free period is modelled as a triangle distribution with minimum zero, model value of 10% and maximum of 20%, giving an average of 10%.

For the void period variable, Gerald Eve kindly provided an estimate from the data collected for the Multi-Let Report (2010, 2011), which was 7 months. However, this excluded units that were void at the time of entry into their database and were still void at the time of the latest report. Hence, the true average is likely to be higher. Empirical evidence shows that some units can be empty for long periods of time and eliminating the possibility of this through the use of a triangle distribution chosen to produce for example, a 7 month average may reduce the incidence of downside scenarios unrealistically.

The lognormal distribution allows us to model a non-negative variable with a high chance of a low value occurring and a small chance of much higher values occurring and this was considered for the void period. M7, a fund and asset manager specialising in the light industrial sector kindly provided a small sample of data on new lettings in the last two years for 95 units where the previous void period was recorded. The data came from a cross section of units of different sizes with an overall un-weighted average vid period of 6.6 months, similar to the Gerald Eve figure. As before the sample excludes units that were still void and so the true average will be higher. A log-normal distribution was fitted to the data but it was found that it was a poor fit and rejected at the 5% significance level by a chi-square test.

Given the rejection of the lognormal distribution, a triangular distribution was adopted with a minimum of 1 month, a maximum of 24 months and a modal value of 6 months. This set of parameters produces a mean value for the void period of 10.3 months. This is higher than the values reported by Gerald Eve and M7, though we know these to be biased downwards. The maximum of 24 months is in line with the M7 data but is clearly smaller than what is possible in practice.

In summary, the parameters of the triangle distributions are set initially as follows:

Term of new let	Duration (yrs)
Lower bound	1
Upper bound	7
Mode	3

Rent free period	% Lease length
Lower bound	0
Upper bound	20%
Mode	10%

Void period	Duration (mths)
Lower bound	1
Upper bound	24
Mode	6

Example

Using the above assumptions for a single lease with a maturity in 3.5 years, and carrying out 1,000 simulations we obtain the following distribution of annual income:

Table 1: Single lease income

	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
mean	20,000	20,000	20,000	12,034	14,654	18,469	17,309	16,252	16,109	16,100
5%	20,000	20,000	20,000	10,082	-	10,082	9,841	3,342	3,260	1,699
25%	20,000	20,000	20,000	10,082	9,973	20,000	15,068	13,315	11,767	13,260
50%	20,000	20,000	20,000	10,082	20,000	20,000	20,000	20,000	20,000	20,000
75%	20,000	20,000	20,000	13,425	20,000	20,000	20,000	20,000	20,000	20,000
95%	20,000	20,000	20,000	16,767	20,000	20,000	20,000	20,000	20,000	20,000

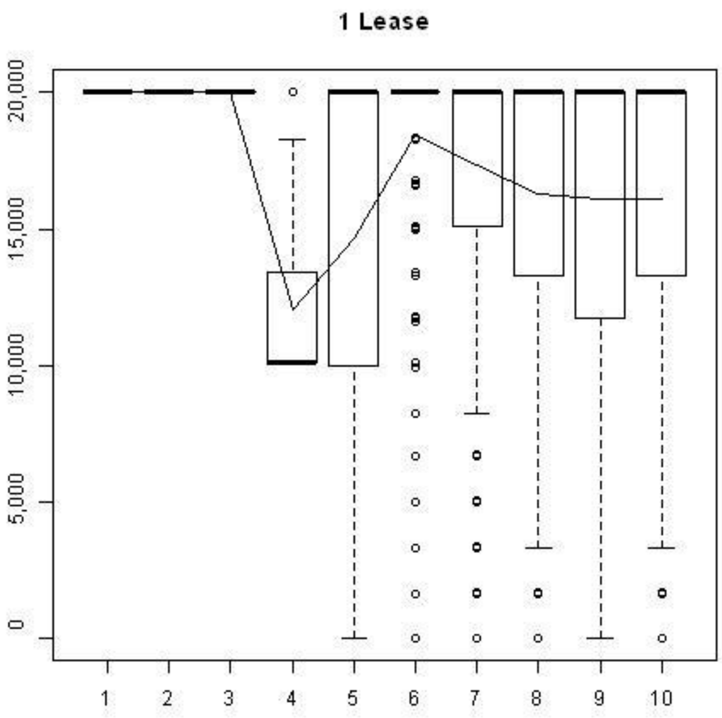
As different portfolios will have different portfolio income we present results expressed as a percentage of the initial portfolio income.

Table 2: Single lease income percentages

	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
mean	100%	100%	100%	60%	73%	92%	87%	81%	81%	81%
5%	100%	100%	100%	50%	0%	50%	49%	17%	16%	8%
25%	100%	100%	100%	50%	50%	100%	75%	67%	59%	66%
50%	100%	100%	100%	50%	100%	100%	100%	100%	100%	100%
75%	100%	100%	100%	67%	100%	100%	100%	100%	100%	100%
95%	100%	100%	100%	84%	100%	100%	100%	100%	100%	100%

Graphically this can be represented with a box and whisker plot showing the interquartile range (boxes), minimum and maximum (bars at end of dotted lines) and outliers (as small circles). The mean is plotted as a line.

Chart 1: Single lease income distribution



The zero risk of default means that the income in the first 3 years is certain to be £20,000. In year 4, there is a very high expectation of a sharp fall in income, with an average value of over £11,000. From year 5 onwards, the upper quartile range is capped at the maximum of £20,000 but there is a very wide range of possibilities with less income, owing to the different possible combinations of rent free and void periods. This reflects the high degree of uncertainty associated with short leases.

To determine whether a particular reduction in portfolio income constitutes a significant shortfall we need some reference level of income. Different investors will have differing income requirements and so we present results in terms of the percentage of initial income although we cannot easily describe the significance of a particular level of income shortfall for a general investor. However, we can consider the level of income required to service a given level of debt secured on the notional portfolio. The property market relies heavily on debt finance and the capacity of a portfolio of assets to service debt will often be an important consideration in the decision to buy a particular asset or portfolio of assets.

Borrowing is assumed to be undertaken at 50% loan to value ratio (LTV), with an interest cover ratio (ICR) of 2.5, i.e. the rent is required to be at least 2.5 times the interest expense. The LTV is at the upper end of what is achievable in today's lending market although before the financial crisis much higher LTVs were commonplace. The ICR is also typical of today's loan covenants for secondary industrial. Interest rate margins have risen substantially since the financial crisis reaching 2.5% for secondary industrial in 2010 and up to 3.5% by the end of 2011 (De Montfort 2011, 2012).   All in borrowing cost is initially assumed to be 5.5%, based on a 5 year swap rate of around 1.5%[2] and making an allowance for mandatory costs and bank arrangement fees. The cost of borrowing is determined on a fixed rate basis as banks normally require loans to be fixed, at least for a majority of the principal. The sensitivity of the results to changes in interest rates will be examined.

Results

Scope of study

The study analyses a number of sets of portfolios containing different numbers of leases and different levels of initial void. In each case we ran 1,000 simulations. We first consider our base case multi-let portfolio of 12 leases. The results for this portfolio are as follows:

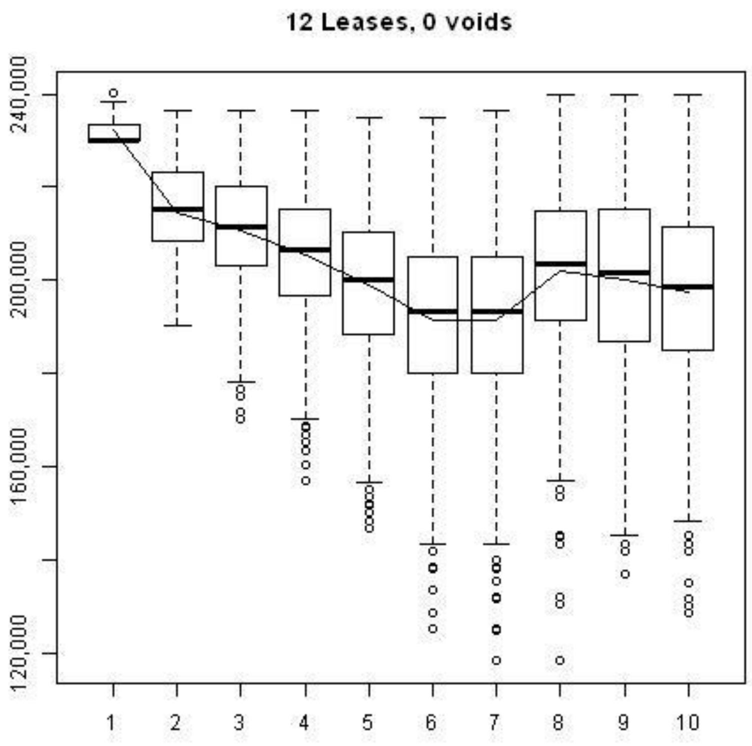
Table 3: Income as % of initial rent: Twelve leases, 0 initial voids

	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
mean	97%	89%	88%	86%	83%	80%	80%	84%	83%	82%
5%	96%	81%	79%	75%	71%	65%	66%	71%	69%	68%
25%	96%	87%	85%	82%	79%	75%	75%	80%	78%	77%
50%	96%	90%	88%	86%	83%	81%	81%	85%	84%	83%
75%	97%	93%	92%	90%	88%	85%	85%	90%	90%	88%
95%	99%	96%	95%	94%	92%	91%	92%	95%	96%	94%

[2] 1.4% to 1.8% in 2012; source: Bank of England Statistics

Graphically the income projections can be illustrated as set out below. The average level of income in each year decreases in the early years and then flattens out. At the same time the range of possible outcomes increases rapidly in the early years.

Chart 2: Income distribution: Twelve leases, 0 initial voids



For a portfolio of 12 leases we find for example, that there is a 50% chance of being below 86% of the initial portfolio income in year 4. In years 6 and 7 there is a 5% chance of portfolio income being less than 66% of its initial value. Even for an ungeared investor the possibility of such a large reduction in income may be problematic.

Different investors and funds will have different tolerances to shortfalls in income and it is not straightforward to judge what level of shortfall risk is unacceptable to a general investor. However, we can also interpret the probability distributions for an individual portfolio by considering the likelihood of breaching the debt covenants that would apply for a loan secured on this portfolio.

We find that there is zero probability of being unable to meet the interest payments, owing to the high spread between the rental yield and the interest rate. Intuitively, we would expect there to be a small possibility for a small portfolio of leases to fail to meet the interest payments in a very bad scenario but this does not show up under the base case assumptions. The assumption of a triangular distribution for the key letting variables sets a maximum for the void and rent free periods and so means that the downside is limited.

Although the interest payments are always covered we find that the portfolio of 12 leases has a 7% chance of failing to meet the ICR covenant in year 4 and a 35% chance of failing to meet it in year 7. These probabilities of shortfall on their own are likely to make lending against such a small portfolio an unviable proposition. This study considers only income shortfall risk but the capital value of the asset will almost certainly fall in circumstances where the income has reduced significantly, even if market pricing is unchanged.

Table 4: Probability of breaching ICR: Twelve leases, 0 initial voids

Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
0%	0%	2%	7%	17%	32%	35%	16%	19%	22%

We ran a set of similar simulations for portfolios that were multiples of the twelve lease portfolio with no voids, i.e. portfolios of 24 leases, 36 leases etc., until we found a portfolio large enough so that the probability of default on the ICR covenant during the 10 year period was less than 5%. A portfolio with a risk of breaching the loan covenant of less than 5% in any year was considered sufficiently well diversified.

For a portfolio of 240 leases with no initial void the income distribution is broadly similar in shape but with a much narrower interquartile range. This portfolio was found to have a probability of breaching the ICR covenant of less than 5% in every year.

Chart 3: Income distribution: 240 leases, 0 initial voids

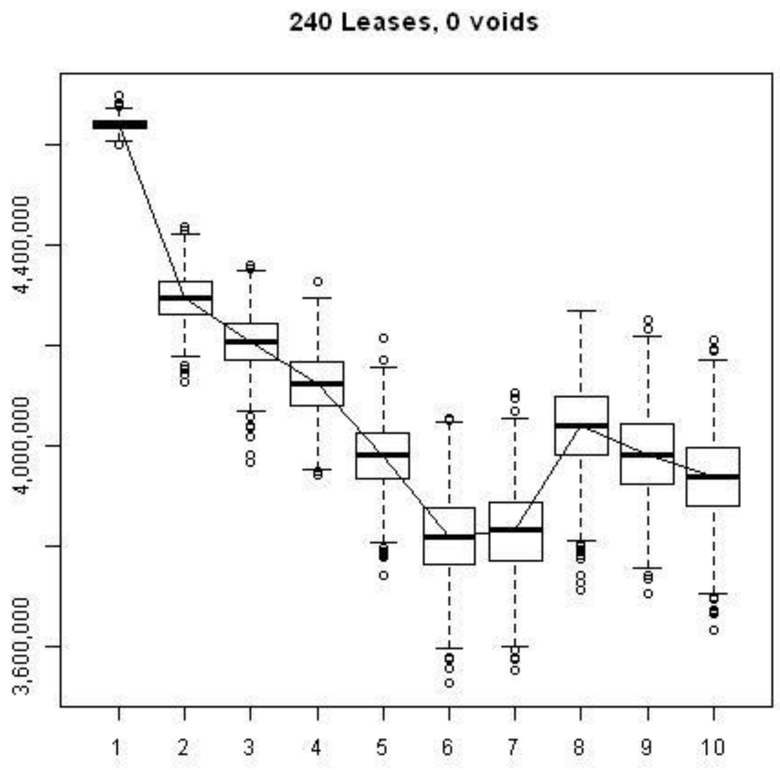


Table 5: Probability of breaching ICR: 240 leases, 0 initial voids

Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
0.0%	0.0%	0.0%	0.0%	0.0%	3.5%	3.7%	0.0%	0.0%	0.3%

A portfolio of 240 units, which would typically comprise approximately 10-20 estates, has a total value of £53.4m assuming each unit has an ERV of £20,000 and is valued at 8.5% net initial yield.

The results are of course sensitive to the assumptions. As well as the distributional assumptions for void period, rent free and term of new lease, the starting configuration of lease maturities will also affect the results. The low points in the income occur in years six and seven, which occur around the time of the expiry of the longest original leases. The choice of lease maturities was somewhat arbitrary and intended to provide a wide spread around the target mean. However, the average lease length could be achieved with many different combinations of lease maturities. For example, a base unit of 8 leases with maturities of 1.5 years, 2.0 years up to

5.0 years has an average lease length of 3.25 years. The results for a portfolio of 240 leases based on the 8 lease unit the results are as follows:

Table 6: Probability of breaching ICR: 240 leases, 0 initial voids, 8 lease base unit

Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
0.0%	0.0%	0.0%	0.0%	5.6%	7.2%	0.0%	0.0%	0.4%	0.6%

The different distribution of lease maturities, though still well spread, produces an increase in the risk of breach of the income covenant to 7.2% in year 6 and is over our 5% threshold in two years out of ten. The 8 unit portfolio of 240 leases is reasonably well spread in terms of maturity but not as well spread as the 12 unit portfolio.

We also consider an even more well spread portfolio of leases, one with a base unit of 24 leases, with the shortest at 0.25 years, rising to 6 years at 0.25 year intervals. This portfolio has one year where the chance of breaching the ICR is slightly above 5%.

Table 7: Probability of breaching ICR: 240 leases, 0 initial voids, 24 lease base unit

Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
0.0%	0.0%	0.0%	0.0%	0.0%	5.8%	0.0%	0.0%	0.4%	0.6%

The wider spread of lease maturities reduces the risk of shortfall to just one year of the ten year period.

Turning to the results for portfolios of leases containing some level of initial void, we are faced with the issue of valuation. If void units are priced at zero then clearly such portfolios will generate higher levels of income than a portfolio of the same number of leases with no voids. Even if we consider only portfolios of increasing size but with the same level of initial void, in order to make the same assessment about whether a portfolio is sufficiently well diversified we need a value for the portfolio.

The analysis being undertaken focuses on the tails of the distribution of future portfolio income. Small differences in income will affect the conclusion as to whether the portfolio is sufficiently well diversified according to the criteria specified. In contrast, the differences in capital value between the different valuation assumptions are large. For example, for 240 leases with no initial void, the assumed value is £53.4m, compared to £48.9m for a portfolio of 240 leases with 20 initial void units if the void units are valued at zero. The difference in value of £4.5m produces a difference in rent required to meet the ICR of £612,000 p.a. This extra rental income requirement is much larger than the differences in income produced by the two portfolios over the whole 10 year period. This suggests that the assuming that void units are priced at zero is inconsistent with the distributional assumptions. The assumptions made are that each unit is identical save for the term to maturity of the initial lease. A void unit will produce the same income over the long term as a unit that is occupied initially save for the initial difference owing to the void. Hence the value of a void unit is simply the value of an occupied unit discounted over the expected non-incoming producing period at an appropriate discount rate. Whichever discount rates are used to calculate the discounted value, within reason, will produce a much smaller difference in capital value. For example, using a non-income producing period of 12 months and a discount rate of 8% produces a difference in capital value of only £0.3m. On this basis comparisons will be made between portfolios with void units valued an ERV yield basis, i.e. void units will have the same value as occupied units. This valuation assumption is the most consistent with the other simulations assumptions.

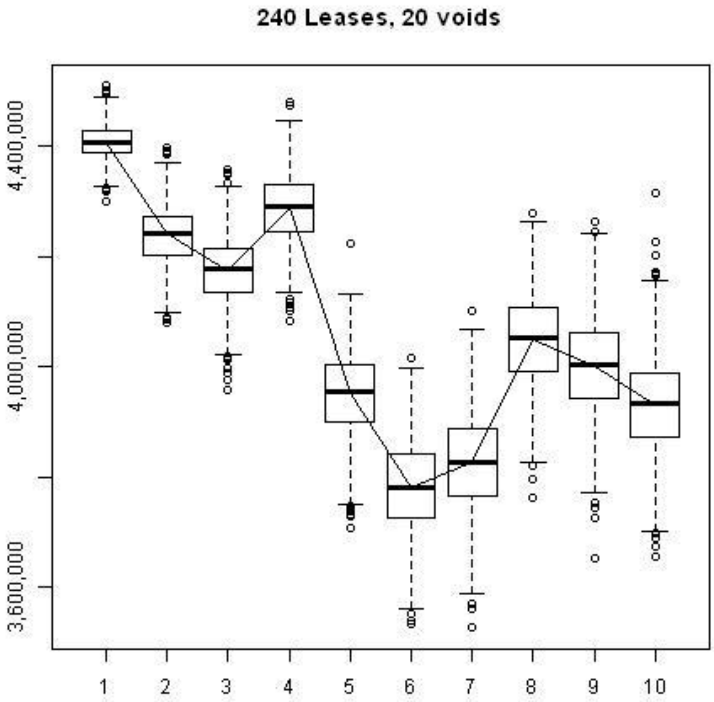
A portfolio of 240 leases, of which 1 in 12 is void initially, produces the following chances of breaching the ICR covenant, assuming a void unit is valued the same as an occupied unit:

Table 8: Probability of breaching ICR: 240 leases, 20 initial voids

Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
0.0%	0.0%	0.0%	0.0%	0.0%	9.1%	4.1%	0.0%	0.1%	0.1%

There is a modest increase in the chances of breaching the ICR covenant compared to the no void case.

Chart 4: Income distribution: 240 leases, 20 initial voids



All of the units have the same probabilities of renewal etc. and so the starting configuration of lease maturities and voids determines the income distributions in the early years. However, after a sufficient period of time has elapsed the income distributions will converge to their long term patterns as can be seen demonstrated in charts 3 and 4. We find that it is necessary to increase the portfolio size to 336 before the risk of ICR covenant breach is below 5% in each year for a portfolio where 1 unit in 12 is void initially.

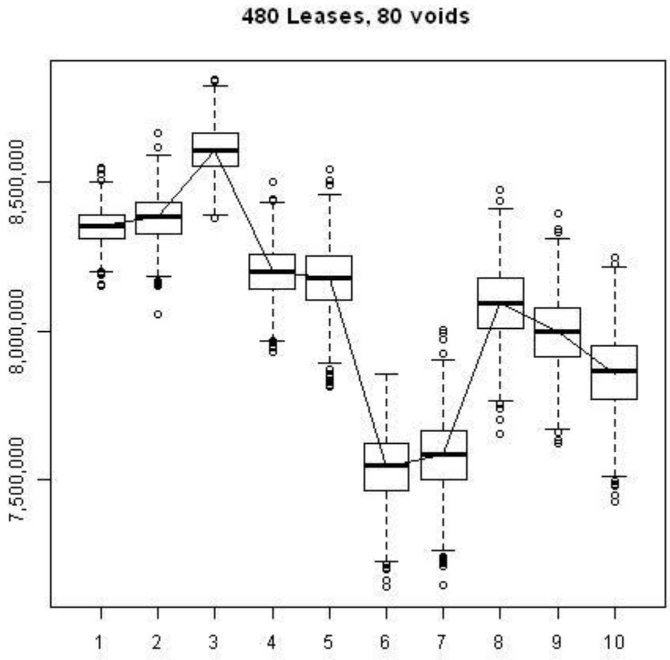
For a portfolio with two initial voids in every twelve lease group the results are as follows:

Table 9: Probability of breaching ICR: 240 leases, 40 initial voids

Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
0.0%	0.0%	0.0%	0.0%	0.0%	9.1%	8.2%	0.0%	0.1%	0.1%

In order to reduce the risk of ICR covenant breach to below 5% a portfolio of 480 leases is required.

Chart 5: Income distribution: 480 leases, 80 initial voids



The pattern of income distribution across the years is similar to other portfolios; the initial voids mean that we need a larger number of leases to narrow the quantile ranges sufficiently to meet the ICR covenant test.

Interest rate sensitivity analysis

Looking at the interest rate assumptions, the very low level of interest rates by historical standards suggest that it would be informative also to consider the results when assuming a higher interest rate for the simulations.

Using a borrowing cost of 6.0% we find significant differences in the size of portfolio required to reduce the chance of a breach of the ICR covenant to below 5%. For a portfolio of 240 leases with no voids the probabilities of income shortfall are much higher, so much so that a breach of the ICR is almost certain.

Table 9: Probability of breaching ICR: 240 leases, 0 initial voids, 6.0% borrowing cost

Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
0.0%	0.0%	0.0%	3.4%	59.3%	98.9%	98.1%	33.8%	55.2%	79.5%

With 600 leases and a 6.0% interest rate the probabilities of an ICR breach are in fact worse:

Table 10: Probability of breaching ICR: 600 leases, 0 initial voids, 6.0% borrowing cost

Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
0.0%	0.0%	0.0%	0.3%	68.2%	100%	100%	26.1%	57.7%	91.2%

For the current set of re-letting assumptions, an LTV of 50% and an interest rate of 6.0% it is not possible to reduce the chances of a breach to below 5%.

Keeping the interest rate at 6.0% but reducing the LTV to 45%, we find significantly reduced chances of an ICR breach.

Table 11: Probability of breaching ICR: 240 leases, 0 initial voids, 6.0% borrowing cost, 45% LTV

Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.3%	0.0%	0.0%	0.0%

Clearly the required portfolio size is very sensitive to the assumed interest rate and LTV. With this combination of LTV and interest rate, it is possible to reduce the size of the portfolio to 108 leases and still have a 5% or less chance of an ICR covenant breach.

Table 12: Probability of breaching ICR: 108 leases, 0 initial voids, 6.0% borrowing cost, 45% LTV

Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10
0.0%	0.0%	0.0%	0.0%	0.0%	4.6%	3.3%	0.0%	0.4%	0.8%

What does the high degree of sensitivity of the results to the LTV and interest rate tell us about diversification potential and portfolio size? The diversification test that we have applied is to reduce the chance of an ICR covenant breach to below 5% in any single year. For some combinations of LTV and interest rate it is impossible to do this. For other combinations, it is easy to do this – evidently as we reduce the gearing level towards zero the chances of breaching the ICR covenant diminish to zero. For combinations of LTV and interest rate where it is feasible, our analysis identifies the size of the smallest portfolio for which it is possible to satisfy the diversification test for the given set of assumptions.

Short term interest rates are currently exceptionally low and this would favour borrowing on a floating interest rate basis, in which case the required portfolio size would be smaller for any given LTV. However, banks normally require at least the majority of the interest rate exposure to be fixed so these scenarios have not been examined further.

Summary and conclusions

This study has considered how many leases are necessary within a portfolio of multi-let assets to achieve an adequate level of diversification of the portfolio income. The definition of adequacy is defined as having a less than 5% probability of a portfolio breaching the interest ratio cover covenant on a notional loan over a ten year horizon. Multi-let industrial assets have short leases and so are subject to frequent lease events, which put portfolio income at risk. The study uses Monte Carlo simulation techniques to address the question as there are many interacting variables. Parameter inputs are derived from current market data as far as possible.

Considering a base portfolio of twelve leases, with an average term to maturity of 3.25 years and no initial voids, we find that there is a 35% chance of breaching the ICR covenant in year 7, based on the initial set of assumptions. Even if the intended investment horizon were only 5 years, this probability of breach is important as it will affect the value of the asset at year 5.

If we increase the portfolio size to 240 leases, with no initial voids, we find that the probability of breaching the ICR covenant falls to below 5% in each year. A portfolio of 240 leases would have a value of approximately £53.4m on the assumptions used.

For portfolios which contain initial voids we find that the risk of breach is increased, assuming that the void units are valued on the same basis as the occupied units. Given the set of assumptions being used, this was considered the most appropriate basis on which to value the void units. If the void units were valued at zero, then the risk of breach would decrease substantially. In practice, the valuation of void units is not carried out in isolation but rather the whole estate is valued as one asset. The overall valuation yield may mask many different sets of assumptions about re-letting and void periods, and if the property is being marketed for sale each potential purchaser will carry out his own analysis. Differences in opinion of value will be manifested in the prices that are offered, each of which implies a particular valuation yield, sometimes referred to as the all-risks yield. An alternative way of applying the type of analysis that has been carried out would be to use it to determine the maximum price (lowest yield) that could be paid for a given set of borrowing conditions.

For the portfolio structures assumed, we find that we need a portfolio of 336 leases if there is one initial void unit in every twelve and a portfolio of 480 leases if there are two initial void units in every twelve.

The base assumptions include an all-in borrowing cost of 5.5%. If this is increased to 6.0% we find that it is not possible to create a portfolio that reduces the risk of ICR covenant breach to below 5%. Reducing the LTV to 45% we find that a portfolio of only 108 leases is required. Clearly the required portfolio size is very sensitive to the assumed interest rate and LTV and for some borrowing terms it is impossible to meet the diversification requirements. The analysis helps us to identify the smallest portfolio possible for any feasible set of borrowing conditions.

The results are inevitably sensitive to the assumptions made, including the numerical assumptions for variables used in the simulations and factors excluded from the analysis such as credit risk and void costs. The latter two will work to reduce the income achievable from a portfolio and so increase the number of assets required for adequate diversification over the estimates derived above. The simplifying assumption of equal weighting across the portfolio will also lead to under estimate the number of assets required as value-weighting acts to increase risk.

The analysis has also assumed that rental growth is zero. Positive rental growth will reduce the chances of an income breach although nominal ERV growth has only averaged -0.2% for the industrial sector over the last ten years to December 2011[3].

The numerical assumptions are based on a limited sample of market information and this is an area where further data would be useful. The correlations of the key variables across different assets and time periods and the interactions of the key

[3] IPD UK Monthly Index April 2012

variables are likely to prove difficult to identify[4] but these assumptions may be crucial when analysing live portfolios of assets.

The triangle distribution has been assumed for the three key variables of term on new letting, rent free period and void period. The triangle distributions used omit the possibility of very large values of the variable. For the void period especially, this may result in a significant underestimate of the potential of income breach as practical experience tells us that void periods can run to several years or more, in contrast to the maximum of two years assumed in this analysis.

The results have been derived by considering a hypothetical portfolio of multi-let assets. However, the same approach could be applied to a portfolio of any types of property asset. A portfolio consisting of many single-lets is a very similar investment[5], mathematically at least, and could be analysed in the same way. However, the capital requirements to achieve adequate diversification would be considerably higher owing to the larger unit size.

In practical use of this type of modelling the numerical assumptions could be tailored to meet the particular asset or assets in question. For example, if the asset was located in a location for which historic letting data were available, the income projections could be based on distributions that matched the historical data. Alternatively, the asset could be analysed initially using generic market wide data and the assumptions then adjusted to determine what would be required to meet a specific income distribution target. In this way, owners or prospective purchasers can better understand the practical implications of performance targets in terms of probabilities of letting, void periods and new lease length.

The type of analysis undertaken for this study has natural applications in a several areas of property investment decision making. The average lease length is reducing across the whole market and therefore understanding risks to the income from a

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[4] The Strutt & Parker IPD Lease Events Review may be helpful in this regard.

[5] Mitchell (2012) remarks that a portfolio of single-lets may offer better diversification possibilities than multi-let assets.

property asset will become more important for investors and lenders. Property valuers may also find this type of analysis useful. For investors and lenders, income risk is an important consideration at an individual asset level but also for portfolio construction. For example, an asset that offers a satisfactory return on its own merits may have a similar income risk profile to other assets in the existing portfolio and so increase income risk rather than reduce it. Income risk analysis also has applications in determining optimal lease structures where multiple alternatives are not easily evaluated by conventional means.

Income risk analysis has many applications and can be developed much further than the model presented in this paper. The simulation model used can also be extended to incorporate the impact of capital movements, thus producing a full scale risk model. Whilst the potential value movements from shifts in yields are likely to have much larger impacts on returns than income shortfalls in isolation, the income is the numerator in the value calculation and hence is of critical importance in determining value. A fully functional risk model will incorporate detailed income modelling. From a performance perspective, recent work in the US (Feng and Geltner 2011) suggests that property-level operational management outperformance (i.e. income delivery) is the single most important factor in determining outperformance. Whilst simulation techniques employed to analyse prospective income returns are no substitute for hard property management graft, they are a useful starting point in understanding what is possible and where the risks to performance lie.

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Appendix 1

Portfolio structures

Each portfolio consists of 12 leases with an average time to expiry, ignoring void units, of close to 3.25 years.

	Maturity in years				
Lease	No void	1 void	2 voids	3 voids	4 voids
1	0.5	0.5	0.5	0.5	0.5
2	1.0	1.0	1.0	1.0	void
3	1.5	1.5	1.5	1.5	1.5
4	2.0	2.0	2.0	void	void
5	2.5	2.5	void	2.5	2.5
6	3.0	void	3.0	void	3.0
7	3.5	3.5	3.5	3.5	3.5
8	4.0	4.0	void	4.0	4.0
9	4.5	4.5	4.5	void	void
10	5.0	5.0	5.0	5.0	5.0
11	5.5	5.5	5.5	5.5	void
12	6.0	6.0	6.0	6.0	6.0
Average lease length	3.25	3.27	3.25	3.28	3.25