Blending Public and Private Real Estate Allocations for Defined Contribution Pension Funds: A UK Case Study

Abstract

This paper analyzes the implications of combining public real estate with a direct real estate allocation. Using actual fund rather than index data, the historic performance of blended portfolios has been simulated and the resulting risk and return characteristics analyzed. The results show that the public real estate component has been accretive to performance in blended real estate portfolios. When accounting for valuation smoothing and the non-normal characteristics of private real estate returns, we show that risk contributions were consistent with asset allocations. In addition, the blended portfolio still provided the multi-asset benefits of private real estate exposure.

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1) Introduction

It is well understood that direct real estate can be a beneficial component of a multi-asset portfolio, primarily due to the diversification benefits that it provides. However, post the GFC there has been a greater investor focus on liquidity and there is now a clear need to incorporate liquid real estate investments in portfolios to meet the needs of Defined Contributions ("DC") Pension Funds, a burgeoning investor group. One of the key challenges for both asset allocators and product developers is how to provide a direct or at least a direct-proxy real estate exposure in a mixed asset portfolio with acceptably high levels of liquidity. By way of example, in the UK there is a daily liquidity requirement for investment funds and products targeting this segment of the pension funds universe. As a result these products must have sufficient self-contained liquidity so that they are able to satisfy investor redemptions over this frequency. This is a challenge for all private market asset classes but clearly a 100% exposure to private funds or direct real estate would not be expected to meet this demanding criteria. There are also the practical implications of the need to hold some cash in the portfolio, as well as incorporating the associated transaction costs of managing and rebalancing portfolios.

The rationale for this paper is to analyze the risk and return implications of combining public real estate with a direct real estate allocation. We believe there needs to be a greater clarity on the longer term delivered risk-return and multi-asset implications for investors who chose this blended route. There are a number of reasons why this study differs from prior work and adds to the current thinking on real estate portfolio construction. Notably, this study uses actual fund rather than index data (i.e. measures delivered returns to investors), has chosen a global rather than single country public real estate securities allocation and is focused on providing clarity around the real estate exposure for a specific investment requirement, the UK DC Pension Fund market. Whilst public markets can be passively replicated, this is not possible for direct real estate and so tracking error is inevitable when allocating to the asset class via fund conduits. Risk is also quantified using a measure which better accounts for downside potential. Elevated volatility has always been seen by non-users of public real estate as a major disadvantage.

The next section provides a review of the relevant academic literature on this topic. This is followed by an overview of the available dataset and methodology employed with the results and analysis sections of the combined real estate portfolio following thereafter. Finally the multi-asset impact of the combined portfolio is assessed and we then draw together our conclusions and offer suggestions for further research in this area.

2) Prior Literature

A number of studies have sought to provide a better understanding of the performance and risk characteristics of including both public and private real estate allocations within portfolios, as well as their interrelationships over time. It has been shown that direct real estate allocations provide good diversification benefits to multi-asset portfolios but there has been less research on the benefits associated with blended real estate portfolios, i.e. those which include both public and private exposures.

A number of studies, such as Lee (2005), have looked at the role of incorporating direct real estate in a mixed asset portfolio. Lee's starting point was the Booth and Fama (1992) observation that the compound returns, and so the terminal wealth, of a portfolio are greater than the weighted average of the compound returns of the individual investments, a difference referred to as the RDD. This counterintuitive result stems from the fact that although variance is an appropriate measure of risk of a portfolio, it is not the relevant measure of the risk of the investment within a portfolio. The risk of an investment within a portfolio should be measured by its covariance with the portfolio. Lee's results show that adding real estate to an existing mixed-asset portfolio generally increases the RDD and so the terminal wealth of the mixed-asset portfolio. It was noted that the results are dependent on the percentage allocation to real estate and the asset class replaced.

Bond et al (2007) investigated the performance of a set of alternative asset classes and their contribution to a multi-asset portfolio. The historical risk-adjusted performance of these asset classes differed dramatically over the sample period. Private equity and infrastructure showed

high returns but also high levels of risk. Direct real estate was shown to have attractive risk and return characteristics for a U.K. institutional investor. They found that portfolio volatility could be substantially reduced by including real estate but that a significant reduction wasn't achieved by including one of the other alternative asset classes. On a risk-adjusted basis, real estate was one of the best-performing asset classes over the sample period studied and had significantly better risk hedging characteristics than any of the other asset classes. As to whether these benefits could be derived by substituting other alternative assets for real estate, the emphatic answer is that no other asset class delivered the same level of risk adjusted returns.

Lee (2010) found that whilst a number of studies have examined the allocation of public real estate securities (REITs) in the mixed-asset portfolio, no study had explicitly examined what benefits REITs offer to the traditional capital market mixed-asset portfolio (i.e., whether REITs are a return enhancer, diversifier, or both). This paper examined this issue using the method suggested by Liang and McIntosh (1999), which decomposes the overall risk-adjusted benefits of an investment to an existing portfolio into its diversification benefits and return benefits. The results show that REITs offer different benefits to different asset classes in the mixed asset portfolio and that these benefits have changed over time. Thus, whether REITs can have a place in any future mixed-asset portfolio largely depends on the relative return performance of REITs versus the alternative asset classes within the mixed-asset portfolio. Lee and Stevenson (2005) showed that the diversification benefits from REITs improved as investment horizon increased.

Hoesli and Oikarinen (2012) demonstrated very clearly the link between public and private real estate in their international study. Their study covered the period 1994-2010 and their aim was to examine whether securitized real estate returns reflect direct real estate returns or general stock market returns using data for the US, UK and Australia. In contrast to previous research, which generally relied on overall real estate market indices and neglected the potential long-term dynamics, their econometric evaluation was based on sector level data and catered for both the short-term and long-term dynamics of the assets as well as for the lack of leverage in the direct real estate indices. Their results showed that long-run public real estate market performance is much more closely related to the direct real estate market than to the general stock market. The results are of relevance regarding the relationship between public and private markets in general,

as the ‘duality’ of the real estate markets offers an opportunity to test whether, and how closely securitized asset returns reflect the performance of underlying private assets

Yunus et al (2012) studied the long-run relationships and short-run linkages between the private (unsecuritised) real estate markets of Australia, Netherlands, UK and the US. Their results indicated the existence of long-run relationships between the public and private real estate markets of each of the markets considered. Consistent with other studies they found that the public real estate markets lead the private real estate markets. Glascock et al (2003) also showed that a cointegrating relationship between REITs and private real estate markets exists. Ang et al (2013) found a common real estate cycle across public and private US real estate markets. This common real estate factor was shown to be highly persistent, reflecting the cyclical nature of real estate. It was broadly exposed to procyclical market factors. Thus there is a good deal of evidence suggesting that public and private market performance is closely related over the long term.

Turing to the research on blended public and private real estate portfolios, Stevenson (2001) demonstrated that the inclusion of domestic and international public real estate securities allocations diversified direct US real estate portfolios. However, the results were largely contingent upon whether the direct portfolio was itself well diversified by sector and/or US region. The NAREIT study (2011) focussed on US markets and showed that an optimally blended portfolio including approximately one-third in REITs has provided stronger returns, even on a risk-adjusted basis than portfolios dominated by private real estate investments. A blended portfolio of private equity real estate and about one-third publicly traded REIT investments produced positive double-digit or single-digit average annual without a single period of negative returns – even during the most recent real estate market downturn.

Esing et al (2013) examined a US defined contribution investor’s portfolio diversification benefits from incorporating allocations to private real estate (core open-ended fund index), domestic REITs and a blended 75:25 private:public real estate exposure. The impact of these allocations is considered in the context of a typical DC plan asset allocation over its lifetime glide-path. The study showed that a 10% allocation to the blended real estate solution

substantially reduces portfolio volatility but did not result in a material reduction in the overall delivered total return. Thus, risk adjusted returns were significantly improved and the maximum drawdown measure saw a notable improvement from this inclusion of a private-public real estate allocation.

One of the key issues with direct or private real estate is that because of the illiquidity and time it takes to rebalance portfolios, unrealised gains can disappear before they can be captured in practice. One of the key advantages in using public real estate is that can allow tactical or rules-based rebalancing to capture gains and minimise losses. This should lead to enhanced performance relative to a buy-and-hold strategy. Clare et al (2012) examined the effectiveness of applying a trend following methodology to global asset allocation between equities (split between emerging and developed), bonds, commodities and real estate. For real estate, they focussed on public real estate, using the FTSE/EPRA/NAREIT Global REIT Index, as well as country level EPRA Indices for Australia, Belgium, France, Germany, Hong Kong, Italy, Japan, Netherlands, Singapore, Sweden and the UK. The period covered was 1994-2011. The application of trend following led to a substantial improvement in risk-adjusted performance compared to traditional buy-and-hold portfolio both in terms of improved returns and reduced risk.

3) Dataset & Methodology

The methodology used in this study is to simulate the historic performance of portfolios which comprise varying allocations of private pooled UK real estate funds, global public real estate securities funds and cash. To that end, we are seeking to understand the characteristics of the performance delivered to investors through a real estate product which is compatible with the needs of UK DC pension plans. In terms of portfolio composition, an allocation to cash has been made to provide an active liquidity buffer, which is consistent with market practice. Clearly public securities provide significant liquidity to the portfolio but we do not view an allocation to them simply as a liquidity buffer, or cash proxy.. Rather they form an important performance component of a blended portfolio and should be held strategically, to benefit from their real

estate return characteristics. . The danger in treating public securities purely as a cash proxy to meet normal redemption flows is that this would negate the fund manager's ability to capture gains and minimise losses based on stock market valuation factors. Rather, the REIT allocation in general would be determined by the level of redemptions in the fund at any one time, and individual stock selection would most likely focus purely on the liquidity of a REIT's shares rather than the intrinsic value of its assets, quality of its real estate assets, stock market valuation or management team's ability to enhance value.

As this study seeks to estimate realistic investor total returns from exposure to a pooled fund solution, we have created a sample comprising both existing private real estate and public real estate securities (REIT) funds. The sample comprises five private managed real estate funds and four global public securities funds. The sample time series data available was for the 15 years to 30th June 2013. The global public real estate securities funds data was sourced from Bloomberg and is denominated in US dollars. The funds are all open-ended. Unhedged UK Sterling based performance was found to be closely related to performance in US Dollar terms i.e. that currency risk was essentially neutral over the full 15 year period. This was due to the impact of currency risk being dominated by global public real estate security market movements. Given this, and both due to the additional complexity of managing a currency hedging programme and the potential incompatibility of currency derivative instruments within many UK pension schemes, an unhedged USD exposure was assumed for the purposes of this study.

The five UK private real estate funds are sizeable managed open-ended real estate funds (i.e. they reinvest income) and quarterly performance was provided by Investment Property Databank ("IPD"). As at 30th June 2013 these five funds provided investors with exposure to £5.9 billion NAV. These funds have open-ended structures and typically hold cash balances of 5-8% of NAV. The total returns provided did not include the impact the subscription/redemption costs, but are calculated net of fees and fund operating costs. The estimated TER for these funds is approximately 0.9% of NAV p.a. Monthly cash yields were sourced from the Bank of England. Summary statistics for the sample data is as follows:

Table 1: Summary Statistics - 30th June 1998 to 30th June 2013

Asset Class	Mean	Maximum	Minimum	Volatility	Skewness	Kurtosis	JB Test
UK Private Real Estate Funds	1.7%	7.1%	-11.5%	3.2%	-2.0	8.1	107.3***
Global Public Real Estate Funds	2.7%	29.1%	-21.4%	10.0%	-0.3	3.2	0.9
Cash	0.9%	1.9%	0.1%	0.5%	-0.5	1.8	5.8*

**** p<0.01 ** p<0.05 * p<0.10*

A feature of financial market and private investment returns is that the historic return distributions differ markedly from the often assumed normal distribution, due to material skewness and/or kurtosis. Thus far the non-normal characteristics of the real estate performance data used in this study has not been considered. The high negative skewness and positive kurtosis statistics demonstrate that it is likely that the real estate total return distributions will differ from a normal distribution. Whilst the industry continues to be focussed on volatility based risk measures given the inherent non-normality of direct real estate performance, volatility is not an ideal risk measure for this asset class. There is a substantial body of literature which has addressed this issue e.g. Young (2008). To test for this we have used the Jarque-Bera normality test and the results of this are also shown in Table 1. The test statistics show that only private real estate funds are found to be non-normal at the 5% statistical significance level. Not considering the significant negative skew seen in these private real estate total return distributions could lead to downside risk being understated.

The key aim of this study is to provide a better understanding of the risk-return dynamics of a 'real-life' DC real estate portfolio which reflects investor level charges and underlying costs. A portfolio simulation model was used to undertake this analysis. Given the requirement for additional liquidity in any DC real estate product, a 5% cash requirement has been incorporated in the portfolio. The entry costs into private real estate funds and necessary rebalancing cost to maintain a target allocation have also been incorporated. UK open-ended private real estate funds operate bid-offer spread pricing with typical entry costs of 3-6% and exit costs ranging from 1-2%. A 0.25% fee is applied to global public real estate security fund transactions.

To maintain a target allocation over time there is a requirement to rebalance the portfolio on an on-going basis which will lead to cost leakage. It is assumed that the portfolio is rebalanced on a quarterly basis to bring its allocations back in-line with stated strategic portfolio allocation

targets. Other considerations included the effect of valuation smoothing and substituting underlying private and public funds depending upon their relative performance. Having estimated the historic 15 year performance for simulated portfolios, a range of risk measures could then be calculated.

To measure downside portfolio risk two Value-at-Risk (VaR) measures are employed namely Normal VaR and Modified VaR. VaR is a risk measure which estimates the potential investor loss on an asset/portfolio portfolio at a given confidence interval over a given time period. Normal VaR is calculated using the first two statistical moments of the reference asset or portfolio return distribution. Thus Normal VaR is defined by the mean return, volatility of returns and a confidence level and its formula is as follows:

$$Normal\ VaR = \mu + \sigma c_v \quad (1)$$

$$Normal\ VaR = w_i^{'}\mu + \sqrt{w_i^{'}\Sigma w_i}c_v \quad (2)$$

Where μ = mean, σ = volatility and C_v is the confidence interval.

Given only the first two statistical moments are utilized for this measure non-normalities aren't incorporated. Whilst the industry continues to be focused on volatility based risk measures given the inherent non-normality of direct real estate performance, volatility is not an ideal risk measure for this asset class. Thus we have used the Modified VaR measure was used to capture any non-normalities in the data.

$$Modified\ VaR = \mu + \sigma c_v + \sigma\left(\frac{1}{6}(c_v^2 - 1)s - \frac{1}{36}(2c_v^3 - 5c_v)s^2\right) + \sigma\left(\frac{1}{24}(c_v^3 - 3c_v)k\right) \quad (3)$$

These risk measures were also decomposed to assess the key contributors to risk and return from the portfolio's real estate investment conduits and cash over the full 15 year horizon. As shown by Gregoriou and Gueyie (2003) this measure can be used as the denominator to calculate a Modified Sharpe Ratio with excess asset/portfolio returns being the numerator. This is viewed as a more accurate measure of risk adjusted performance when asset/portfolio returns are non-normal. Following Boudt et al (2008) who showed that the Modified VaR method is linear homogenous, the contributions to risk from portfolio assets and their respective statistical characteristics are as follows:

$$Return\ Contribution\ From\ Asset\ i = \ w_i \mu_i \tag{4}$$

$$Volatility\ Contribution\ From\ Asset\ i = \ w_i + \frac{2(\Sigma w)_i}{\sqrt{w_i' \Sigma w_i}} c_v \tag{5}$$

$$Kurtosis\ Contribution\ From\ Asset\ i: \tag{6}$$

$$\frac{2(\Sigma w)_i}{\sqrt{w'\Sigma w}} \left(-\frac{1}{48}(c_v^3 - 3c_v)k_I\right) + w_i \sqrt{w'\Sigma w} \left(-\frac{1}{24}(c_v^3 - 3c_v)\frac{\partial k_I}{\partial w_i}\right)$$

$$Skewness\ Contribution\ From\ Asset\ i: \tag{7}$$

$$\frac{2(\Sigma w)_i}{\sqrt{w'\Sigma w}} \left(-\frac{1}{12}(c_v^2 - 1)s_I + \frac{1}{72}(2c_v^3 - 5c_v)s_I^2\right) + w_i \sqrt{w'\Sigma w} \left(-\frac{1}{6}(c_v^2 - 1)\frac{\partial s_I}{\partial w_i} + \frac{1}{18}(2c_v^3 - 5c_v)s_I \frac{\partial s_I}{\partial w_i}\right)$$

The sum of the Kurtosis and Skewness contributions show in Equations (7) and (8) can be considered the 'non-normal contribution' to portfolio risk as measured by the Modified VaR.

We believe that this is the first study to estimate the 'true' investor risk-return payoff when making a real estate allocation. Following the Legal and General/Nest 70%:30% lead and including a cash allocation we define a 70%:25%:5% UK private, global public and cash allocation to be the "DC Real Estate Fund".

4) Results

a) The Performance Impact of Transaction Costs and Cash Drag

All results shown below are over the full available sample period between the 30th June 1998 and 30th June 2013. To isolate the impact of holding an element of cash in the portfolio we have separated the portfolios into two groups in the table below. Table 2 shows portfolios comprising various conduit allocations and investor cost inclusion. Relative performance and risk measures are estimated against the IPD UK Monthly All Property Total Returns Index.

Table 2: DC Real Estate Fund Performance and Risk Measures

	UK Private Funds	**UK Private Funds Inc Subscription Costs**	**70:30 UK Private Funds: Global Public Funds**	**70:25:05 UK Private Funds: Global Public Funds:Cash**
Portfolio Allocation				
Private Property Funds	100%	100%	70%	70%
Global Public Funds	0%	0%	30%	25%
Cash	0%	0%	0%	5%
Portfolio Statistics				
Annualized Mean	6.79%	6.40%	7.69%	7.13%
Annualized Geometric Mean	6.75%	6.33%	7.54%	6.98%
Annualized Volatility	6.37%	6.48%	8.42%	8.01%
Beta vs IPD Monthly Index	0.88	0.88	0.93	0.88
Tracking Error vs IPD Monthly Index	1.32%	2.01%	5.38%	5.22%
RSq with IPD Monthly Index	0.97	0.92	0.60	0.60
Normal VaR - 95%	-3.54%	-3.73%	-5.00%	-4.70%
Modified VaR - 95%	-4.80%	-4.97%	-6.14%	-5.83%
Sharpe Ratio	0.67	0.60	0.62	0.58
Modified Sharpe Ratio	0.35	0.32	0.33	0.30
Information Ratio - IPD Monthly Index	-0.34	-0.42	0.08	-0.02

Clearly both transaction costs and the cash allocation "drag" the performance of the private real estate funds incrementally. The additional performance benefit from including a 30% public allocation is evident with an improvement of c. 0.9% p.a. over a private only exposure post the impact of costs and cash. The CAPM Betas of the private and blended portfolios have similar

coefficient sizes of approximately 0.9. The private real estate funds used in this study typically carry significant cash balances and hold predominantly stabilized assets, and as a result a lower CAPM Beta than one was an expected result. Due to the impact of cash positions and subscription costs even a well-diversified UK private real estate fund exposure carries a meaningful degree of tracking error (2.0%) against the UK direct real estate market. What the analysis shows is that a DC Real Estate Fund incurs an additional 3% tracking error over an investor level exposure to private real estate funds. Ultimately, this additional tacking error is the cost to investors of garnering both additional liquidity and returns.

The Sharpe Ratio is used to assess the impact on risk adjusted returns of adding public to the portfolio (a 2.5% risk free rate has been assumed). Given that annualized volatility increased from 6.5% when there was 100% private real estate exposure to 8.0% for the DC Real Estate Fund and subsequent 0.9% improvement in returns, there has been a reduction in the Sharpe Ratio. That being said, the ratio only modestly declines suggesting on a risk adjusted basis investors are broadly compensated for the additional volatility of a public exposure. This measure also ignores the improved liquidity.

Table 3 shows the impact of substituting the best and worst performing UK private and global public real estate funds, there is a 1.1% per annum performance differential. Interestingly the best funds also delivered a lower risk portfolio and the worst funds a higher risk profile than the average. Thus the 'best' funds in this study's sample not only show improved absolute performance but also markedly improved risk adjusted performance.

Table 3: The Performance and Risk Impact of Substituting the Best and Worst Funds

	Average Funds	**Best Funds**	**Worst Funds**
Portfolio Allocation			
Private Property Funds	70%	70%	70%
Global REIT Funds	25%	25%	25%
Cash	5%	5%	5%
Portfolio Statistics			
Annualized Mean	7.13%	7.89%	6.77%
Annualized Geometric Mean	6.98%	7.82%	6.53%
Annualized Volatility	8.01%	7.62%	8.84%
Beta vs IPD Monthly Index	0.88	0.82	0.96

Tracking Error vs IPD Monthly Index	5.22%	5.15%	5.79%
RSq with IPD Monthly Index	0.60	0.58	0.58
Normal VaR - 95%	-4.81%	-4.29%	-5.58%
Modified VaR - 95%	-5.98%	-5.44%	-6.75%
Sharpe Ratio	0.58	0.71	0.48
Modified Sharpe Ratio	0.30	0.36	0.25
Information Ratio - IPD Monthly Index	-0.02	0.13	-0.08

b) Non-Normality and Portfolio Risk Attribution

As shown above the private real estate returns exhibit non-normality and this study has made use of the Modified VaR statistic to better account for this characteristic of the performance data. Table 4 shows the VaR estimates and also the attribution of risk and return to the three asset class components within the DC real estate portfolio (as per the Boudt (2008) methodology outlined above). The risk attribution is considered for three absolute measures of risk:

Table 4: DC Real Estate Fund Risk-Return Attribution

	Portfolio	**Private Property Funds**	**Global REIT Funds**	***Cash***
Portfolio Allocation		**70%**	**25.0%**	**5.0%**
Return	1.8%	1.1%	0.7%	0.0%
Volatility	-6.5%	-3.0%	-3.5%	0.0%
Normal VaR - 95%	***-4.7%***	***-1.9%***	***-2.8%***	***0.1%***
Skewness	-1.3%	-1.2%	-0.1%	0.0%
Kurtosis	0.2%	0.2%	-0.1%	0.0%
Non-Normal	-1.1%	-1.0%	-0.2%	0.0%
Modified VaR - 95%	***-5.8%***	***-2.9%***	***-2.9%***	***0.1%***
Volatility Contribution		**46.7%**	**53.4%**	**-0.1%**
Normal VaR Contribution		**41.5%**	**59.6%**	**-1.1%**
Modified VaR Contribution		**50.4%**	**50.5%**	**-0.9%**

What the risk attribution shows is the significant risk contribution of global public real estate fund volatility which contributes over 50% of total portfolio volatility, double its equity allocation. Interestingly when accounting for non-normality, private funds are the source of

almost the entirety of the risk emanating from this source, due to the significant negative skewness of its return distribution. Whilst only a modest shift, the Modified VaR measure shows that private funds contribute 50% total risk, whereas when VaR is estimated assuming a normal distribution the contribution is 40%.

c) Impact of Valuation Smoothing Upon Performance

As noted above, private real estate performance is characterized by appraisal lag which creates serial correlations in periodic total returns e.g. Geltner et al (2003) and Lizieri et al (2012). This is a characteristic which acutely manifests when a greater period frequency is assumed for performance. This occurs due to the fact that as the periodic frequency increases then there is less new information available for advisors to update their valuations, which leads to a greater dependence upon prior period values. This consequences of this are well documented, namely that volatilities and co-variances with more liquid asset classes are underestimated. This can be seen in Table 5 where we have made use of the longest series of private UK real estate fund total returns available to estimate historical annualized total returns and volatilities. The AREF/IPD Managed Property Funds Index has been used as it the most relevant index for the sample of private real estate funds used in this study which are all managed funds. These have been calculated using both quarterly and annual total returns and contrasted with direct market performance, as well as the sample data.

Table 5: Historic Performance Data Risk-Return Statistics

	June 1990 - June 2013		**June 1998 - June 2013**	
	Annualized Mean	**Annualized Volatility**	**Annualized Mean**	**Annualized Volatility**
Quarterly Data				
IPD UK Monthly Property Index	7.29%	6.35%	7.24%	7.07%
AREF/IPD Managed Property Funds Index	5.97%	6.18%	6.32%	6.45%
UK Private Funds (Study Sample)			6.79%	6.39%
Global Public Funds			10.80%	19.90%
Annual Data				
IPD UK Monthly Property Index	7.95%	11.69%	7.99%	12.89%
AREF/IPD Managed Property Funds Index	6.52%	11.25%	6.91%	11.51%

UK Private Funds (Study Sample)	7.42%	11.67%
Global Public Funds	10.60%	18.80%

Table 6 shows that when using the same return series, the annualized volatility materially increases when measuring performance on an annual basis, compared to using quarterly performance numbers. This isn't the case for more liquid asset classes. For example the volatility estimate for the global public securities fund sample used in this study shows a far less material difference in annualized performance volatility when switching between quarterly and annual measurement periods. There are a number of econometric approaches that can be employed to correct for smoothing bias in performance series. This includes methods which account for varying degrees of smoothing throughout the market cycle (Lizieri et al (2012)). Given the relatively limited historic time series available in this we have adjusted the private UK real estate funds using the following simple formula:

$$R_t \text{ (Unsmoothed)} = (Rt - \alpha\, Rt\text{-}1) / (1- \alpha) \qquad (8)$$

Where α is a coefficient which adjusts for first order serial correlation in the data. This is typically estimated using a first order autoregressive model.

For the purposes of this study we set α to a value 0.65 which unsmoothed the UK private real estate funds performance data. The impact that this adjustment has upon risk and return can be seen in Table 6 the performance of the DC real estate fund has been estimated using these unsmoothed private real estate fund returns:

Table 6: Unadjusted vs Unsmoothed Private Real Estate Fund Performance Summary Statistics

Asset	Mean	Maximum	Minimum	Volatility	Skewness	Kurtosis	JB Test
Private Real Estate Funds	1.60%	7.14%	-11.52%	3.24%	-1.89	7.43	84.73***
Private Real Estate Funds - Unsmoothed	1.61%	16.40%	-23.80%	6.10%	-2.08	10.48	183.11***
DC Real Estate Fund	1.78%	8.83%	-11.54%	4.01%	-1.28	4.98	26.14***
DC Real Estate Fund - Unsmoothed	1.77%	15.30%	-20.10%	5.60%	-1.48	7.91	82.30***

**** p<0.01 ** p<0.05 * p<0.10*

As a result the annualized performance volatility of private real estate funds has increased to 12%. This broadly matches the historic annual volatility estimate for UK private managed property funds shown above. This coefficient essentially means that over a given quarterly period approximately a two-thirds weight was assigned to previous performance and one-third current period market conditions.

Table 7: Unadjusted vs. Smoothed DC Real Estate Fund Performance and Risk Measures

	Unadjusted	**Unsmoothed**
Portfolio Allocation		
Private Property Funds	70%	70%
Global REIT Funds	25%	25%
Cash	5%	5%
Portfolio Statistics		
Annualized Mean	7.13%	7.08%
Annualized Geometric Mean	6.98%	6.59%
Annualized Volatility	8.01%	11.19%
Beta vs IPD Monthly Index	0.88	1.17
Tracking Error vs IPD Monthly Index	5.22%	7.86%
RSq with IPD Monthly Index	0.60	0.53
Normal VaR - 95%	-4.81%	-4.29%
Modified VaR - 95%	-5.98%	-5.44%
Sharpe Ratio	0.58	0.41
Modified Sharpe Ratio	0.30	0.36
Information Ratio - IPD Monthly Index	-0.02	-0.02

The impact of unsmoothing the private fund total returns leads to a clear increase in all risk measures with the absolute volatility of the DC portfolio increasing by c. 40% to 11.2% p.a. Tracking error also materially increases. As returns are stable the Sharpe Ratio is materially

lower. The objective of this exercise was to show risk-return based upon a realistic level of annualized volatility so that a 'true' picture of investor performance and risk can be shown. This is particularly relevant for contrasting performance with liquid traditional asset classes and this is addressed below. The Boudt et al (2008) risk attribution analysis demonstrates that private funds that now contribute to overall DC real estate fund risk to a much a greater extent which is shown in Table 8.

Table 8: Unsmoothed DC Real Estate Fund Risk-Return Attribution

	Portfolio	**Private Property Funds**	**Global REIT Funds**	***Cash***
		70%	**25.0%**	**5.0%**
Return	1.8%	1.1%	0.7%	0.0%
Volatility	-9.1%	-6.3%	-2.8%	0.0%
Normal VaR - 95%	***-7.3%***	***-5.2%***	***-2.1%***	***0.1%***
Skewness	-2.1%	-2.4%	0.3%	0.0%
Kurtosis	0.6%	0.7%	-0.2%	0.0%
Non-Normal	-1.6%	-1.7%	0.2%	0.0%
Modified VaR - 95%	***-8.9%***	***-6.9%***	***-2.0%***	***0.1%***
Volatility Contribution		**69.2%**	**30.9%**	**-0.1%**
Normal VaR Contribution		**71.5%**	**29.2%**	**-0.8%**
Modified VaR Contribution		**78.2%**	**22.4%**	**-0.6%**

When non-normalities are considered then private funds contribute a higher pro-rata share. What is interesting here is that when accounting for smoothing impact, the contribution to risk is broadly in line with the target allocation. Again private funds contribute all of the 'non-normality' risk. Whilst we recognize that this is a synthetic exercise, the analysis nonetheless shows that when estimating the 'true' risk of private real estate performance, it contributes to overall risk to a much greater extent than 'raw' periodic data analysis suggests and investors should be mindful of this finding.

c) A Blended Real Estate DC Fund in a Mixed Asset Portfolio

Finally, we consider the longer-term benefits of incorporating a Real Estate DC Fund in a multi asset portfolio. The summary statistics in Table 9 show the performance attributes of the asset classes included and highlights the non-normality in private real estate returns relative to liquid asset classes.

Table 9: Asset Class Total Returns Summary Statistics

Asset	Mean	Maximum	Minimum	Volatility	Skewness	Kurtosis	JB Test
FT All Share	1.59%	22.43%	-19.53%	8.37%	-0.30	2.97	0.91
FT All Govt Bonds	1.47%	10.24%	-3.76%	2.86%	0.66	3.45	4.88*
Private Real Estate Funds	1.60%	7.14%	-11.52%	3.24%	-1.89	7.43	84.73***
Private Real Estate Funds - Unsmoothed	1.61%	16.40%	-23.80%	6.10%	-2.08	10.48	183.11***
DC Real Estate Fund	1.78%	8.83%	-11.54%	4.01%	-1.28	4.98	26.14***
DC Real Estate Fund - Unsmoothed	1.77%	15.30%	-20.10%	5.60%	-1.48	7.91	82.30***

**** p<0.01 ** p<0.05 * p<0.10*

As can be seen in Table 10, there is a negative relationship between both real estate exposures and bonds. When compared to equities, the global public real estate securities component of the DC portfolio, clearly leads to an increase in correlation. This is as expected given the greater correlation between public real estate and broader equity markets. Whilst we recognize that these correlation relationships shift through the cycle and there are methodologies to account for this e.g. copula modelling, although we do not have sufficient observations in the study sample to utilize them efficiently.

Table 10: Full Sample Correlation Matrix

	FT All Share	FT All Govt Bonds	Private Property Funds	DC Property Fund	Global Public Funds
FT All Share	1				
FT All Govt Bonds	-0.35	1			
Private Property Funds	0.36	-0.34	1		
DC Real Estate Fund	0.64	-0.32	0.82	1	
Global Public Real Estate Funds	0.70	-0.19	0.41	0.85	1

To assess the impact of including both real estate exposures within a multi asset portfolio we show the impact of including the real estate exposures to an existing UK equity and UK government bond portfolio with a 55%:45% weighting. This is based upon a recent survey of UK pension fund holdings (Towers Watson (2013)). Whilst the sample's historical data has been used to estimate correlations and volatilities, we have not used the historic asset class returns given UK equity market performance seen over the period. Instead we have used long term return expectations. For bonds we have assumed an expected return of 4.0% p.a. and an equity risk premium over this of 4.0% p.a.. These have then been adjusted for passive management fees of 0.10% for bonds and 0.15% for equities. A 6.25% p.a. return expectation has been assigned to UK private real estate funds and 7.0% to the DC real estate product.

Whilst portfolio optimization studies tend to suggest very high private real estate allocations, this type of analysis excludes the relative illiquidity of private real estate which is a key risk consideration. To assess the benefits of including real estate in a multi asset portfolio, we show the multi-asset portfolio and its corresponding risk-return statistics, including 10% and 20% allocations to both forms of real estate exposure. This level of allocation is not uncommon, although allocations of 5-10% are more typical. By way of example, NEST has allocated 20% to real estate which is likely to reduce to 15% over time as other real assets are included.

Table 11: Asset Allocation Risk Return Tradeoffs - Unadjusted Private Fund Performance

	Asset Allocation				
Portfolio Allocation					
FTSE All-Share Index	55.0%	49.5%	49.5%	44.0%	44.0%
FTSE Actuaries Govt Securities	45.0%	40.5%	40.5%	36.0%	36.0%
UK Private Funds		10.0%		20.0%	
DC Real Estate Fund			10.0%		20.0%
Expected Return	6.07%	6.09%	6.12%	6.11%	6.16%
Volatility	8.66%	8.00%	8.29%	7.39%	7.97%
Sharpe Ratio	0.41	0.45	0.44	0.49	0.46
Modified VaR	-5.31%	-4.80%	-5.00%	-4.41%	-4.82%
Modified Sharpe Ratio	0.17	0.19	0.18	0.20	0.19

Volatility Contribution					
FTSE All-Share Index	102.10%	99.95%	95.91%	95.88%	89.00%
FTSE Actuaries Govt Securities	-2.10%	-2.79%	-3.47%	-3.51%	-3.24%
UK Private Funds		2.85%		7.63%	
DC Real Estate Fund			7.56%		14.24%
Modified VaR Contribution					
FTSE All-Share Index	126.31%	125.37%	122.31%	120.48%	110.46%
FTSE Actuaries Govt Securities	-26.31%	-27.34%	-28.62%	-27.91%	-25.54%
UK Private Funds		1.97%		7.43%	
DC Real Estate Fund			6.31%		15.08%

Table 12: Asset Allocation Risk Return Tradeoffs - Unsmoothed Private Fund Performance

	Asset Allocation				
FTSE All-Share Index	55.0%	49.5%	49.5%	44.0%	44.0%
FTSE Actuaries Govt Securities	45.0%	40.5%	40.5%	36.0%	36.0%
UK Private Funds		10.0%		20.0%	
DC Real Estate Fund			10.0%		20.0%
Expected Return	6.07%	6.09%	6.12%	6.11%	6.16%
Volatility	8.66%	8.13%	8.37%	7.79%	8.21%
Sharpe Ratio	0.41	0.44	0.43	0.46	0.45
Modified VaR	-5.31%	-4.79%	-4.98%	-4.59%	-4.86%
Modified Sharpe Ratio	0.17	0.19	0.18	0.20	0.19
Volatility Contribution					
FTSE All-Share Index	102.10%	98.79%	95.91%	90.17%	86.44%
FTSE Actuaries Govt Securities	-2.10%	-3.94%	-3.47%	-5.55%	-4.55%
UK Private Funds		5.15%		15.39%	18.11%
DC Real Estate Fund			7.56%		
Modified VaR Contribution					
FTSE All-Share Index	126.31%	127.28%	122.31%	114.69%	110.87%
FTSE Actuaries Govt Securities	-26.31%	-30.79%	-28.62%	-33.19%	-29.59%
UK Private Funds		3.51%		18.49%	
DC Real Estate Fund			6.31%		18.72%

Firstly the results in Tables 11 and 12 demonstrate that portfolio risk-returns are improved when incorporating a real estate exposure. When addressing valuation smoothing, this impact marginally declines. However, the key conclusion here is that, based upon typical investor allocation to real estate, the DC real estate product is still able to provide diversification benefits to investor portfolios. For example when assuming a 20% real estate allocation and unsmoothed private fund returns, overall portfolio volatility reduces by 0.5% (a 5% reduction) versus 0.9% (a 10% reduction) for private funds. Again, due to the presence of a public component the DC Real Estate Fund sees its risk-return benefit decline when compared to a pure real estate allocation, but it is nonetheless still there. This analysis ignores the additional liquidity benefit provided but from a pure expected performance perspective we have quantified the trade-offs for a DC real estate product such as the one assessed in this study.

5) Conclusions

We have used actual fund rather than index based real estate returns as the performance data for portfolio analysis. As a result we are able to make adjustments which will affect investor level returns such as deducting all necessary entry, exit and rebalancing costs, as well as the drag from including a cash exposure. A number of funds have the ability to include public real estate in their portfolio but choose not to do so and a number of investors do not regard public real estate as part of their real estate allocation. These results demonstrate clearly how the returns of a portfolio of UK private real estate funds can include (global) public real estate funds without materially diminishing the diversification benefits of private real estate yet enhance performance, through a relatively simple execution model. In particular we feel that these results have significance for the UK Defined Contribution Pension Fund market where there is a daily liquidity requirement for investment funds and products targeting this segment of the pension funds universe. As a result these products must have sufficient self-contained liquidity so that they are able to satisfy investor redemptions over this frequency.

The study has shown that the public real estate component has been accretive to a blended real estate portfolio's return profile. Over the past 15 years, a 30% public real estate allocation has

provided a total return enhancement of approximately 1% p.a. to the real estate portfolios. Further analysis showed that there was an approximate 0.2% p.a. return enhancement for each 5% absolute increase in global public securities funds at the expense of private real estate. Whilst there was a notable increase in measured volatility risk as a result of this exposure given the return enhancement, the impact upon risk adjusted returns was limited. It was also shown that there was an additional 4% tracking error cost relative to the direct UK real estate market when including 30% global public allocations. We believe that this is surprisingly small given that the public element comprises global rather than purely UK stocks. We also find that c. 1.3% tracking error arises for a well-diversified private portfolio highlighting that pure private real estate index performance is unachievable.

While the volatility of public securities is well-known, it is equally well-recognised that the true volatility of private real estate is commonly under-stated. We refined our measurements for risk by i) explicitly accounting for the non-normal characteristics using the Modified VaR measure and ii) adjusting for the inherent valuation smoothing in private real estate performance. Once these aspects were addressed in measured risk it was shown that private funds contributed to a much greater share of overall risk to the point where the risk contributions were broadly in line with the asset allocations. We then modelled the impact of using the DC Real Estate Fund rather than a 100% private exposure in a simplistic mixed asset portfolio including UK equities and bonds. The overall risk-return impact of using either real estate exposure was extremely similar and marginally better if unsmoothed data was used as a comparable. In that instance the Sharpe ratio modestly increased for the mixed asset portfolio over the 15 year period, whether a 10% or 20% real estate weighting was used.

There is a clear need for further work in this area given growing requirements for more liquid exposures in real estate and other real asset portfolios. This study analyzed one specific solution which has been adopted in the UK market. Further work should focus on the studying the ‘optimal’ real estate portfolio allocations to both domestic and global private and public exposures. The results of this are likely to vary by the investor jurisdiction under consideration. Additional work should also explore the use of periodic portfolio rebalancing using rules or more quantitative approaches. This could result in improved performance and/or risk mitigation. There

is also scope to widen this beyond real estate and to consider other real asset classes such as infrastructure and timberland investments. Again the balance between public and private allocations within an optimal ‘real asset’ solution could be considered.

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