IPF Research Programme 2006-2009

Real Estate's Role in the Mixed-Asset Portfolio: A Re-examination

Summary Report

March 2012

IPF Investment Property Forum

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This Programme has supported the IPF's wider goals of enhancing the knowledge, understanding and efficiency of property as an investment class. The initiative has provided the UK property investment market with the ability to deliver substantial, objective and high quality analysis on a structured basis. It will enable the whole industry to engage with other financial markets, the wider business community and government on a range of complementary issues.

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1. EXECUTIVE SUMMARY

- This paper summarises the results of the IPF Research Programme 2006–2009 research project examining real estate returns and risk in a multi-asset context. The research was conducted by the University of Cambridge's real estate finance group: full findings are available in four working papers published by the IPF.
- The downturn in commercial real estate values commencing in the UK in 2007 provides the context for the research. The falls in value coincided with the onset of the global financial crisis and negative returns in equity markets. Does this imply that real estate's diversification benefits were overstated and that diversification did not occur when it was most needed?
- The research focused on risk in UK commercial real estate at the asset level. It examined the characteristics of real estate returns, the relationship between property (both private and publicly-listed) and other financial assets (equities and bonds) and the extent to which those characteristics and relationships varied over time.
- Any analysis of private property returns has to be mindful of data issues. The research used an innovative valuation desmoothing technique that adjusted the degree of smoothing for different market conditions. Results show that underlying property returns are affected by adverse equity market performance – and that valuation smoothing is more pronounced when market conditions are bad.
- Property returns are shown to be non-normal: there is a higher than expected probability of negative returns and, while most returns are tightly clustered around the mean return, there are 'fat tails' – a higher chance of extreme returns. These features of skewness and kurtosis have implications for risk management in the portfolio. Standard mean–variance asset allocation models may not identify optimal portfolios to reduce risk.
- The relationship between property and financial assets – equities, small-cap stocks and bonds – varies over time. Correlations vary substantially: the three-year correlation between publicly-listed property returns and the stock market varied from less than 0.2 to more than 0.8. Private directly owned real estate had a lower correlation with the equity market but one that has increased over time. The correlation between public and private real estate returns has risen over time.
- The influence of equity and bond returns on the volatility of property returns similarly varied over time. For public real estate, equity market volatility is more significant as a source of risk than underlying real estate variation; for private real estate, equity and bond influences are smaller, though still significant. Surprisingly, equity market influence on real estate returns **fell** at the onset of the global financial crisis.
- Longer-run analyses confirm the influence of equity markets on real estate returns. The equity market tends to lead public real estate; in turn public real estate tends to lead private real estate, even after desmoothing. Shocks in the equity market are transmitted to property markets. The public real estate market responds quickly to such shocks; private real estate responds more slowly but the effects are more persistent.
- The research also addressed the issue of tail dependence: is there a higher than expected probability of negative equity and real estate returns occurring simultaneously? The results suggested that there was – but only for high-frequency (daily) data. As the time horizon lengthened, so tail dependence effects diminished.
- This suggests that tail dependence is a problem largely confined to high-frequency traded real estate security funds that need to rebalance their portfolios on a continuous basis. For other real estate funds, risk management needs to focus on the time-varying (linear) relationships between real estate and other assets.

1. EXECUTIVE SUMMARY

- Overall, the results suggest that real estate risk management is complex. Standard portfolio management models that rely solely on mean return, on standard deviation and on a constant correlation between real estate and other assets may fail to capture all the dimensions of risk. The time-varying relationship between assets and the sensitivity of real estate returns to wider market conditions need to be taken into account.
- Nonetheless, the research confirms that real estate – both private and publicly-listed – does offer diversification benefits in a mixed-asset context. While they did diminish, those benefits did not disappear in the difficult market conditions that followed the onset of the global financial crisis.

2. INTRODUCTION

The downturn in UK commercial real estate capital values and investment returns coincided with the onset of the global financial crisis in 2007. The poor performance of property markets raised concerns about the benefits of including real estate in mixed-asset portfolios. When capital markets are distressed, are the presumed defensive qualities of real estate available to investors? In other words, does real estate provide diversification gains when they are most needed? This new research, funded by the IPF Research Programme 2006–2009, sought to explore this question.

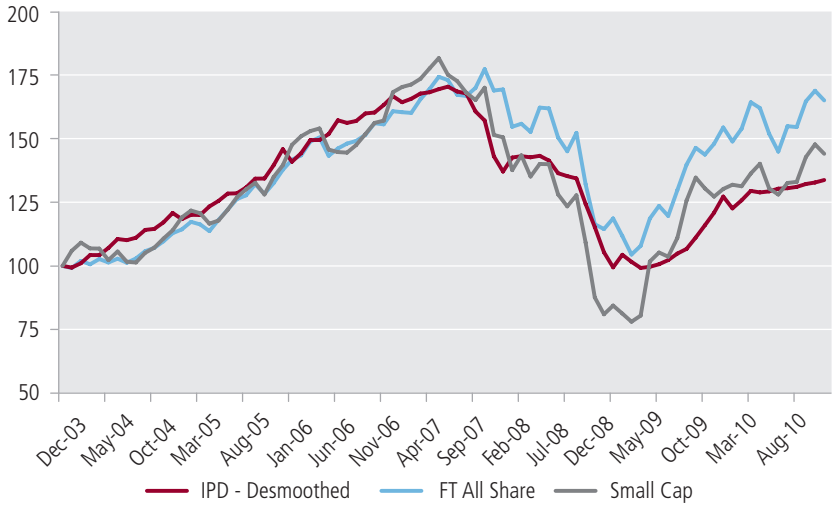
The project focused on the dimensions of risk in property markets, the factors that drive returns, the relationship between real estate and other investment assets and the extent to which those relationships vary over time and are asymmetric in nature. In particular, the extent to which real estate returns behave more like those of other asset classes in difficult economic environments was examined. If that is the case, then conventional arguments on the role of property as a risk diversifier look less strong. However, if it can be shown that commercial real estate continues to behave in a distinctive manner in general asset market downturns and booms, then this provides useful evidence to shape multi-asset portfolio allocation strategies.

The full findings and technical details of the research are presented in four working papers:

Working Paper 1	Real Estate Returns and Other Asset Classes: A Review of Literature
Working Paper 2	Private Commercial Real Estate Returns and the Valuation Process
Working Paper 3	Time-Varying Influences on Real Estate Returns
Working Paper 4	Real Estate Returns and Financial Assets in Extreme Markets

This report summarises the key findings contained in those working papers and sets out the implications of the research. The report complements the IPF's **Risk Web 2.0** project (Blundell, Frodsham and Martinez, 2011) which focused on fund tracking error as a measure of risk and the factors contributing to that. Here, the research team adopts a more conventional finance approach to asset risk and return. The report also develops the work contained in the 2007 IPF report **Asset Allocation in the Modern World**.

Figure 2.1: Real estate and equity indices 2003–2010



Source: IPD, FTSE, Datastream

2. INTRODUCTION

The essence of the question can be seen in Figure 2.1. In the years up to 2007, equities, small-cap stocks and real estate all produced strong positive returns, driven by the general asset price boom generally attributed to excess credit. From 2007, as the global financial crisis spread, all three series experienced a sharp market correction, giving up the gains made during the boom period, before recovering in a somewhat erratic fashion. The picture would be essentially unchanged were property company or bond returns to be added. The key point is that, visually at least, the series track closely – suggesting that there was little diversification benefit to be had from holding a mixed-asset portfolio. This has led to the common assertion that "in the recession, all correlations went to plus one" – that diversification disappeared when it was most needed. The research project sought to provide a rigorous analysis of this assertion in the UK context. Have the events of the global financial crisis undermined the justification for commercial property's place in mixed-asset portfolios?

The report begins with a consideration of the standard mean–variance portfolio allocation model and some data issues in relation to use in real estate markets, it examines the extent to which real estate returns and valuer behaviour varies over time. It then investigates whether the relationship between property and other financial assets is stable over time. Then, the paper focuses on the relationship between real estate and equity markets in extreme conditions – the question of tail dependence. Finally, the report sets out brief conclusions and implications.

3. PROPERTY IN MIXED-ASSET PORTFOLIOS: ISSUES WITH PRIVATE REAL ESTATE

The standard case made for property's role in the mixed-asset portfolio has rested on the favourable risk–return characteristics of private directly held real estate and the low apparent correlations with other financial asset classes. In such analyses, risk is proxied by the standard deviation, measuring the variability of returns around the historic average return. Inputting means, standard deviations and correlations into a portfolio optimiser produces very high suggested weightings for real estate, along much of the efficient frontier, which are far larger than observed in holdings of institutional and professional investors.

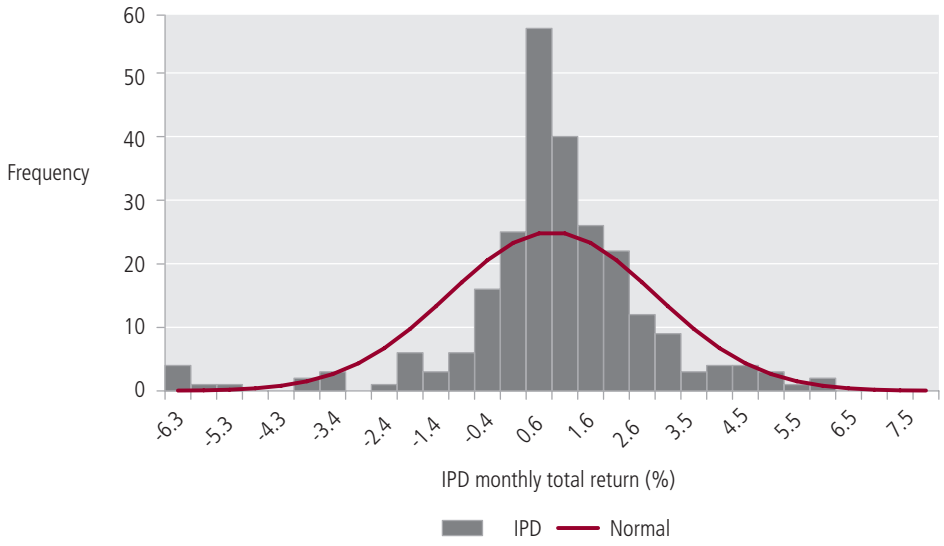
It has long been recognised that this approach is too simplistic. Direct investment in private real estate is problematic, with large lot sizes and heterogeneity making it nearly impossible for all but the largest investors to track a property market index or to diversify property-specific risk fully. Furthermore, the illiquidity of property needs to be accounted for, and transaction costs and other practical management issues also need to be confronted. These make rebalancing a portfolio difficult, driving long holding periods which, in turn, may mean that an initially efficient portfolio becomes suboptimal over time.

A further critical issue to be addressed is the valuation-based nature of most commercial real estate indices. Although there is no absolute consensus, it is generally accepted that valuation-based returns result in smoothing as valuers, for valid, rational reasons, anchor on prior valuations, particularly in markets where there are few relevant transactions. As a result, reported returns may understate the volatility of real estate and lag market turning points. Various methods have been developed to desmooth valuation-based indices. Even using such techniques, however, and adding an illiquidity premium, suggested real estate weightings in conventional portfolio optimisation models remain very high when compared to professional and institutional behaviour.

Furthermore, existing research, confirmed in this study, suggests that real estate returns are not normally distributed. Both private, direct real estate and publicly-listed real estate returns appear to be negatively skewed – that is, there are occasional strongly negative returns, more extreme than a normal distribution based on the average return and standard deviation would suggest. The returns also appear to exhibit kurtosis – that is, the bulk of the returns are clustered around the mean but the tails of the distribution are 'fatter' than would be expected in a normal distribution. This is particularly the case for private real estate returns: for much of the time, returns vary little. However, there are periodic clusters of strongly positive or strongly negative returns. Figures 3.1 and 3.2 illustrate this using monthly data for UK public and private real estate data between 1990 and 2010. In both cases, skewness and, in particular, kurtosis leads to the rejection of normality using standard tests.

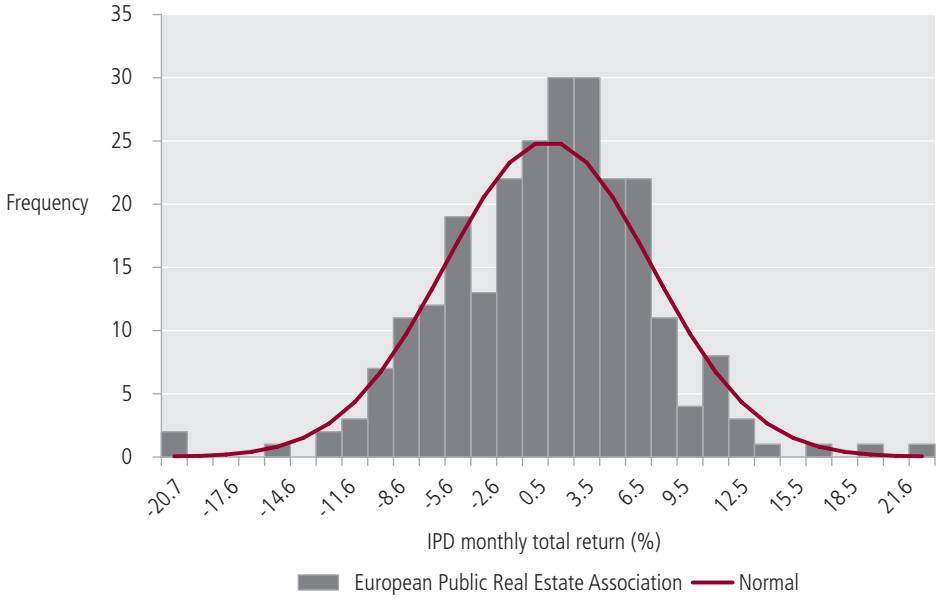
3. PROPERTY IN MIXED-ASSET PORTFOLIOS: ISSUES WITH PRIVATE REAL ESTATE

Figure 3.1: Return distribution, UK private real estate



Source: IPD Monthly Index

Figure 3.2: Return distribution, UK public real estate



Source: IPD, FTSE EPRA/NAREIT

This is not simply an obscure, technical statistical point. Firstly, the return distribution determines the risk characteristics of the asset class. That real estate returns are non-normal[1] implies that it is not sufficient to consider the mean return and the variance of returns. Investors need to consider the risk of the extreme negative (and positive) shocks. Secondly, the distributions suggest that application of the standard Markowitz mean–variance portfolio optimisation process may not be sufficient to generate optimal portfolios. Thirdly, the existence of negative

[1] As are logged returns.

3. PROPERTY IN MIXED-ASSET PORTFOLIOS: ISSUES WITH PRIVATE REAL ESTATE

skewness and fat tails in both real estate and equity markets opens up the possibility that there are relationships – 'dependencies' – between asset classes that are not captured by the correlation coefficient between those assets. For example, the correlation between real estate and equities may be higher in the negative tails of their respective distributions (when equity markets are performing badly, so too are real estate markets). This would be an example of 'asymmetric tail dependence'. Mean–variance portfolios may be suboptimal in protecting investors from such risks.

Another possibility, opened up by the extreme boom–bust cycle of the 2000s, and the apparent common movement of equities, property securities, private real estate and other asset classes over this period, and particularly over the financial crisis phase, is that the relationship between assets varies over time. If this were the case – for example, if the correlation between equities and real estate were time-varying – then a portfolio that was optimal in one period would be suboptimal in another. Even if this were predictable, it would present a problem for private real estate since it would imply the need for frequent portfolio rebalancing, which is problematic given the high transaction costs and illiquidity of directly held private property.[2] The next section considers this issue.

[2] This would be a clear justification for the further development of a liquid and efficiently priced commercial real estate derivatives market, enabling investors to alter exposure at relatively low cost.

4. TIME-VARYING BEHAVIOUR AND PROPERTY RETURNS

Working Paper 2 focuses on valuation processes and the private real estate market. As noted above, there is a broad consensus that valuation-based return indices are 'smoothed' and, hence, understate the level of risk in the underlying property market. The recent publication of the prototype IPD transactions-linked index provides confirmation of this effect, as does the transactions-based index for NCREIF US commercial property returns. The essential idea underlying the smoothing process is that valuers, faced with uncertainty as to the reliability of recent individual transactions data (and relying on historic transactions), adjust or update their prior valuations, which creates a return series that is a moving average, understating periodic market movements. Standard desmoothing models seek to recover the 'underlying' property market returns by filtering out the influence of the prior valuation or return.

In the IPF project, the research introduced two modifications to the standard desmoothing approach which reflect time-variation in returns. Firstly, it explored the possibility that the underlying property return process varies according to market conditions. Building on prior research, the behaviour of real estate may vary depending on external drivers of return such as the macro-economy, the state of the equity market or interest rate shocks. Secondly, the research explored the further possibility that **valuer** behaviour changes over time. In brief, there may be market conditions which lead valuers to smooth more than in normal markets, to anchor more on past values. This might be the case, for example, in difficult markets where trading activity becomes infrequent – the lack of transaction evidence creating greater uncertainty and, consequently, less confidence in moving from the previous valuation.

Technically, the research used a set of statistical procedures known as threshold autoregression (TAR)[3] models. These use an external variable to define a particular market state and then find the best-fit model in each market state. These were used these simultaneously to model both the return processes in UK real estate markets and the behaviour of valuers. The market states were tested using a wide range of variables representing the state of the UK economy, capital market conditions and property market conditions. However, the two variables that were most effective in modelling valuation and return processes were the state of the equity market (measured by returns on the Financial Times (FT) All Share index) and interest rates (measured by three-month LIBOR). Both equity market and interest rate regime models suggested distinctly different behaviour.

When returns were modelled using LIBOR to determine the regimes, it appeared that when interest rates rise above a threshold value, property returns become negative with strong downward momentum, emphasising that leverage brings an increased risk of below-average returns and value falls.[4] With FT returns defining real estate market behaviour, it appears that property returns are positive and stable when equity markets are positive. However, falling equity prices are linked to sharply falling property returns. Fortunately, these low regimes tend to be short-lived. The results are consistent with the skewed and fat-tailed distributions discussed above.

The models also provided evidence that valuer behaviour is time-varying, with smoothing more evident and stronger in the poorly performing down-market states. Equity returns provide the best indicator of valuer behaviour, with very high levels of smoothing occurring when the equity market is in a 'bad' regime of sharply falling prices. This coincides with falling underlying property returns. The analysis was initially run from 1987 to 2008; this was then extended the analysis to mid-2011. Results were broadly consistent. However, it does appear that, after including the period following the onset of the global financial crisis, the commercial property market has become more sensitive to interest rates shocks.

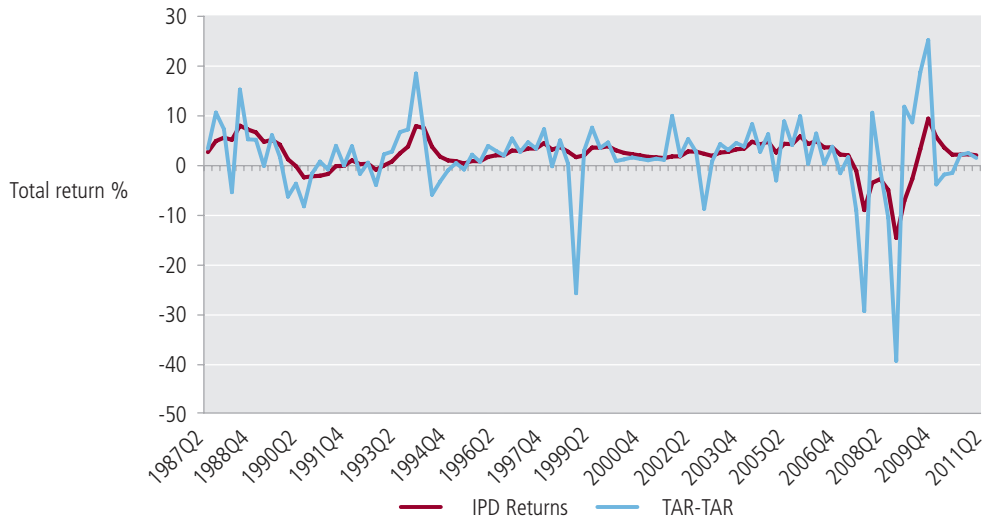
[3] Threshold autoregressive models analyse the behaviour of a variable over time, to test whether that behaviour changes in particular "regimes" defined by the value of some external factor (such as the level of interest rates) or state of the market (for example, whether the equity market is rising or falling).

[4] Analysis suggests that the level of (real) interest rates is a significant driver of performance. A shock **change** in interest rates may have a significant impact on returns – however the impact of that change would depend also on the level of interest rates at that time, and would not be uniform across all levels of interest. That downside risk is emphasised with gearing is consistent with the Black leverage effect in corporate finance.

4. TIME-VARYING BEHAVIOUR AND PROPERTY RETURNS

TAR models are used to produce a desmoothed commercial real estate series. Figure 4.1 shows the impact of the desmoothing process, set against the base IPD valuation-based returns. The sharp positive and, in particular, negative spikes are evident. The quarterly standard deviation of the desmoothed series is approximately double that of the smoothed IPD valuation series – a ratio higher than that produced by the prototype IPD transactions-linked index – which suggests that the valuation-based index understates risk by a factor of approximately 1.4. The greater risk suggested by the threshold model relates to the sharply negative returns generated in the 'bad' regimes.[5] The desmoothed index is used in subsequent analyses of the private real estate market.

Figure 4.1: Desmoothing using the TAR model



Source: IPD, authors' calculations

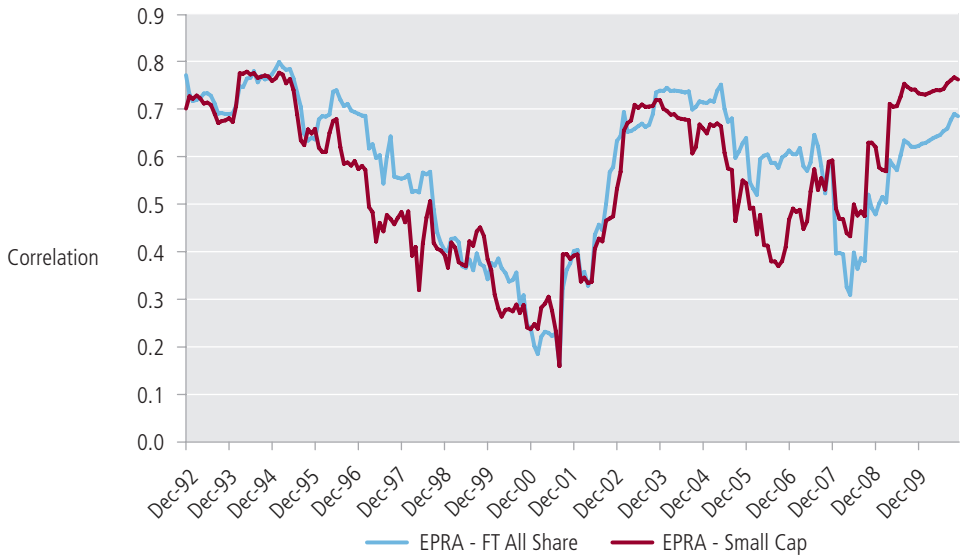
Working Paper 3 examines the time-varying nature of the relationship between real estate (in both public and private markets), equities and bonds over the last 20 years. Most of the standard models of portfolio strategy and asset allocation assume a stable relationship between assets. Does this hold? If not, there are significant implications for allocation models and for risk management. The research used a wide range of quantitative techniques to examine this question.

Figure 4.2 shows the results of a rolling correlation analysis of the relationship between public real estate, the equity market as a whole and small-cap stocks. Correlations are calculated for rolling periods of three years. It is evident that the correlation is not stable over time. From 1992 to 2000, correlations fall sharply, coincident with, and perhaps driven by, the impact of the dot.com and technology stock bubble. They then rise substantially in the run-up to the credit-driven asset boom, but are then unstable – if anything **falling** in the global financial crisis period before rising in the recovery phase. While overall correlations are comparatively high, they are far from stable, indicating that a simple correlation-driven approach to portfolio formation may miss critical dynamics in the interrelationship between property securities and the overall property market.[6]

[5] While the IPD's initiative in releasing the transactions-linked index is welcomed, the IPD transaction basis, as yet, has not been adjusted to reflect 'variable liquidity'. In the US models, if sales volume falls sharply (either because owners are unwilling to crystallise losses or buyers are unwilling or unable to complete) it is assumed that a seller needing to realise their capital would face lower prices and, accordingly the transaction index is downward-adjusted. This would produce a result closer to that found in the desmoothing model.

[6] Formally, of course, the correlations employed in a portfolio model should be **expectations**. In practice, many investors and analysts rely on ex post historical data as input to their optimiser models.

Figure 4.2: Rolling three-year correlations: property companies with equity



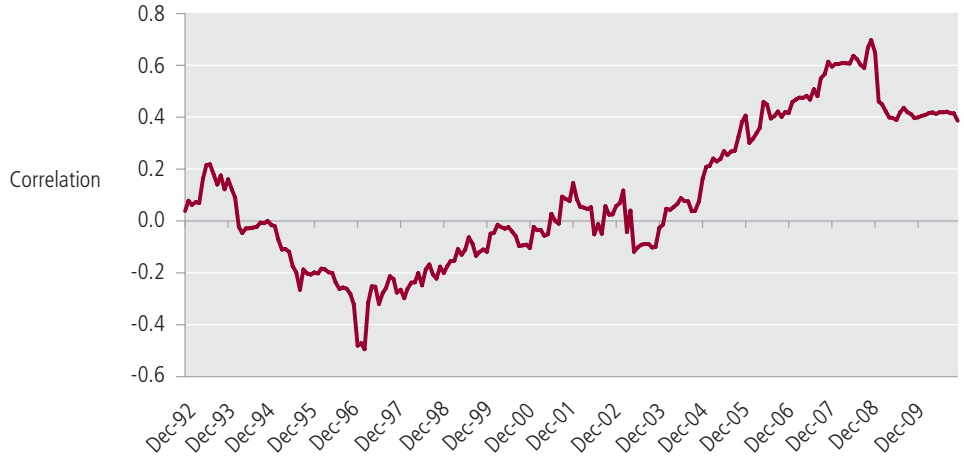
Source: FTSE EPRA/NAREIT, authors' calculations

Figure 4.3 repeats the analysis for the relationship between public property company returns and the performance of the private real estate market (using the desmoothed real estate returns as the its private market indicator). Over much of the early part of the analysis, it seems that property company returns and private real estate returns are little related (there are lead–lag relationships, explored later). However, from the early 2000s, the correlation begins to rise, peaking at close to 0.7 in 2007/2008. It seems as if private real estate and property company returns were behaving in a more similar fashion. In part, this may reflect the 'one way bet' of the credit-driven asset price boom; in part it may reflect more responsive processing of information by the valuation profession.[7] Figure 4.4 shows an unstable but increasing correlation between private real estate and equity market returns. It is noticeable that these rise in the financial crisis – which confirms the earlier analysis which pointed to poor real estate performance when equity markets are troubled, suggesting some tail dependence. Nonetheless, the rolling correlation with FTAS rises only to around 0.5 which suggests that real estate retains substantial diversification benefits in the mixed-asset context.

[7] There is no formal test of this, however.

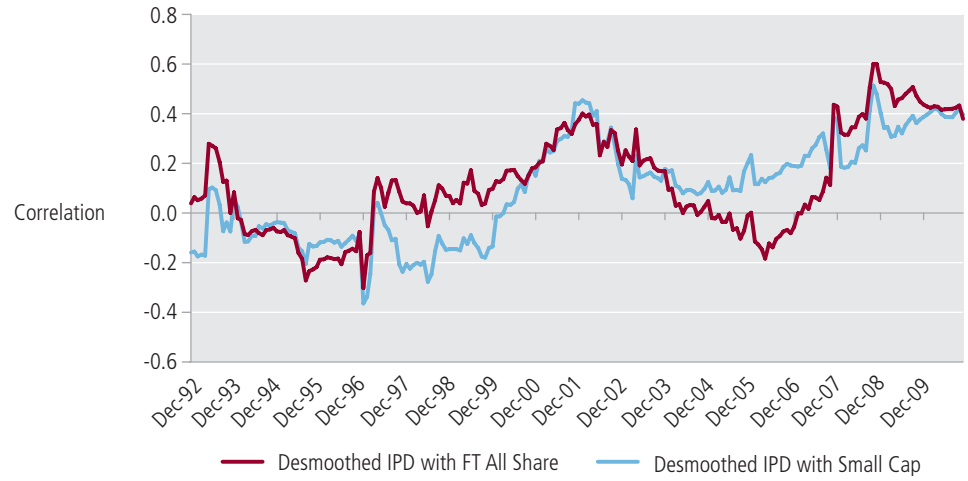
4. TIME-VARYING BEHAVIOUR AND PROPERTY RETURNS

Figure 4.3: Rolling three-year correlation public versus private real estate



Source: FTSE EPRA/NAREIT, IPD, authors' calculations

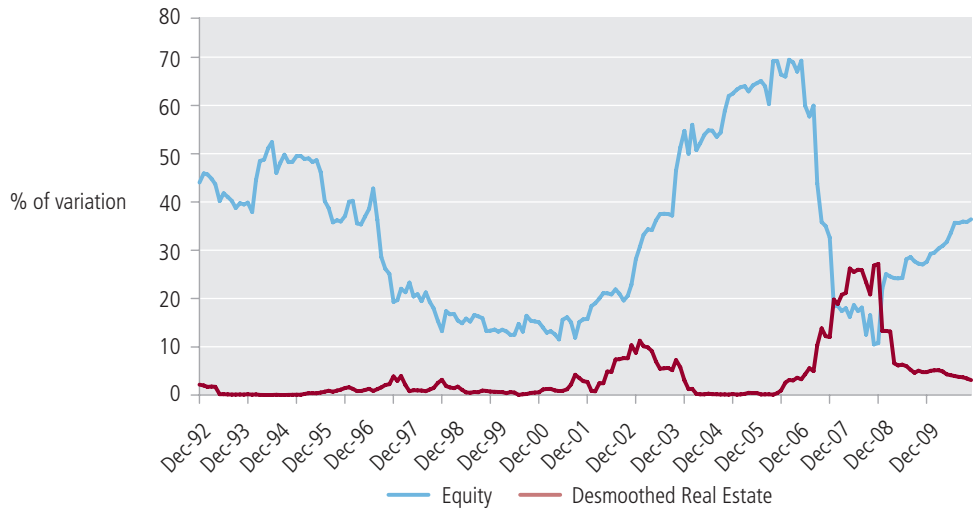
Figure 4.4: Rolling three-year correlations private real estate with equities



Source: FTSE EPRA/NAREIT, authors' calculations

The pattern of time-varying correlations suggests that the influence of financial assets on real estate returns changes over time. To address this formally, factor models were constructed which separate out equity, small-cap, bond and real estate influences into distinct unrelated and independent ('orthogonal') factors. The results here once again demonstrate that equity market and bond market influences on real estate shift considerably over time – there is certainly no constant stable relationship. Thus, property's beta (the sensitivity of real estate to equity market movements) shifts significantly over time.

Figure 4.5: The impact of equity and real estate factors on real estate stocks



Source: FTSE EPRA/NAREIT, authors' calculations

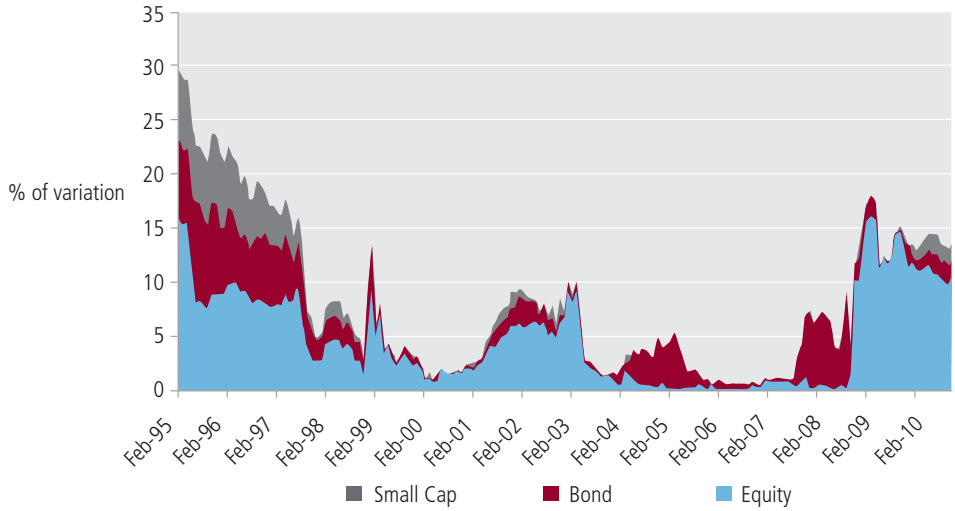
Figure 4.5 compares the influence of the equity market factor and the real estate market factor on the variation in UK property company returns again on a rolling basis (but using a five-year analysis period). The most striking result is that the equity factor is substantially more significant than the real estate factor: at times, equity market movements explain 70% of the movement in listed property returns. This is broadly consistent with prior research. The surprising result, however, comes in the period around the global financial crisis, when the real estate factor assumes a much greater significance. Indeed, in the analysis windows that cover the period of the market correction, the real estate factor becomes **more** important than the equity market factor. This does not conform to the received wisdom that correlations 'went to one' and suggests that listed property stocks and private real estate became more distinct, offering some (short-run) diversification gains.

As Figure 4.6 shows, far less of the variation in private real estate can be related to the equity, bond or small-cap factors, although the degree of explanation varies over the analysis period. There is evidence that the financial assets have become more significant recently, influenced by the financial crisis and continuing capital market problems. Overall, the results suggest that there are significant financial market influences on the volatility of real estate returns, in both public and private markets. Nonetheless, much of the variability in property returns is unexplained, suggesting that diversification benefits do exist. That the movement of private real estate returns seems to be substantially independent of equity and bond influences might reflect the specific nature of the direct (private) market, but may also relate to the role of valuations in private property indices.[8]

[8] An interesting extension would be to deleverage EPRA returns to see the extent to which the equity, bond and small-cap factors are related to capital structure and gearing effects. This would entail making a series of assumptions about sector debt/equity ratios and costs of debt.

4. TIME-VARYING BEHAVIOUR AND PROPERTY RETURNS

Figure 4.6: Direct real estate: factor influences



Source: IPD, authors' calculations

The models analysed thus far have focused on short-run month-by-month or quarter-by-quarter relationships between real estate and other financial assets. A series of long-run statistical and econometric models were also run to shed light on the relationship between real estate and the other financial assets over more sustained holding periods and provide evidence of the dynamics of the relationships between assets. They employed Granger causality tests[9] – which seek to establish whether one asset's returns lead (or lag) those of another. They then used a vector autoregressive (VAR) approach.[10] The VAR model assumes that there is a long-run stable relationship between assets; shocks in one asset market trigger an adjustment process to restore the stable balance.

The results show that public real estate returns lead private real estate returns (despite the use of desmoothed property data). The equity market returns lead both public and private real estate returns, with weaker evidence of a lagging relationship between real estate and small-cap stocks (since small-cap stocks, along with real estate, trade less frequently than larger stocks, it is likely that they will be slower to process new information than the equity market as a whole and, hence, there will be less evidence of any leading relationship with real estate). There is some evidence of a feedback mechanism between bonds and real estate returns, perhaps as a result of interest rate sensitivity.

In the global financial crisis, public real estate returns continued to trail the equity market (with weaker evidence of a feedback mechanism). However, consistent with the factor models described above, private real estate does not seem to have a clear lagging relationship with the stock market. Shocks in public and private real estate markets have persistent impacts on their returns over a number of time periods – it seems as if returns are 'sticky', slow to adjust. Equity market shocks are clearly transmitted into the real estate markets. Public real estate responds significantly, strongly and rapidly; the private real estate response is less strong, but persists for longer. Once again, the results emphasise the long-run links between equity markets and real estate with negative stock market shocks having a significant impact on property returns.

[9] Granger causality is a statistical test used to determine whether one time series is useful in forecasting another or to investigate leads and lags between two series.

[10] Vector autoregression (VAR) is a statistical model used to capture the long run linear dependence among multiple time series.

4. TIME-VARYING BEHAVIOUR AND PROPERTY RETURNS

The evidence presented in Working Paper 3 suggests that both private and public real estate do offer diversification benefits in the mixed-asset portfolio context – even in difficult market conditions. Both are clearly influenced by the performance of financial assets, but retain independence. Private real estate seems to offer greater diversification potential, but this has to be set against concerns over the robustness of data and the practical issues and obstacles associated with investment in the direct market. What is clear, however, is that adopting a single-time-period, mean–variance optimisation approach does not capture the changing risk–return characteristics of property: betas and correlations are time-varying and the influence of other assets on real estate volatility is time-varying. There are periods in the market when the behaviour of the equity market is more closely correlated to that of real estate, and those periods tend to be when the stock market is performing badly. Shocks – negative shocks – in equity returns are transmitted to real estate returns and have a significant effect. A risk management strategy needs to account for these time-varying influences. In particular, for a more complete view of the risk–return characteristics of real estate one needs to consider the relationship between assets at the extremes of their return distributions and seek to identify any 'tail dependence'.

5. TAIL DEPENDENCE BETWEEN REAL ESTATE AND FINANCIAL ASSETS

The fourth working paper for the IPF Research Project focuses specifically on tail dependence, which is the extent to which the probability of jointly occurring negative (or positive) returns between two assets is higher than would be expected from a joint normal distribution of returns between those assets. In essence, the research is attempting to see, statistically, whether there are periods where there is a strong association between sharply negative real estate and equity market returns. Some of the evidence presented here points in that direction: the finding that real estate returns and valuation behaviour are linked to equity market regimes; the increase in correlation between assets as market conditions change; and the transmission of market shocks from equity to real estate. If tail dependence exists, standard portfolio techniques may fail to identify optimal portfolios.

Tail dependence is, however, a complex phenomenon to measure, since linear relationships can generate results that appear to indicate tail dependence but derive from the shock transmission mechanisms described earlier. In Working Paper 4, the research employed a new measure of tail dependence, the 'modified J statistic',[11] which attempted to separate out linear and tail dependence effects. This is econometrically complex and it is difficult to express its nuances in a summary report. Therefore, here the research simply focuses on some of the key findings. The analysis is based on the relationship between public-listed real estate, equities and bonds: the tests involved require high-frequency data.

The results presented in Working Paper 4 suggest that tail dependence with equity returns in UK public real estate is not as pronounced a problem as might be expected based on prior published research. In particular, as the frequency of the returns falls from daily to weekly to monthly, so the significance of any tail dependence diminishes. It seems that tail dependence is significant really only for high-frequency traded funds. Managers who are required to revalue or rebalance their funds and manage their exposure on a frequent basis need to be aware of tail dependence effects and their impact on diversification. There is some evidence that it is possible to derive portfolio strategies that are sensitive to tail dependence issues and that can outperform suboptimal portfolios formed by using a conventional mean–variance approach.

The greater illiquidity, longer holding periods and substantially higher transaction costs make it problematic to apply such models in the private real estate market. However, this also implies that, for longer-term investors, real estate still offers substantial diversification benefits when placed alongside equities in a mixed-asset portfolio – subject to the results discussed earlier and their implications for risk management.

The relationship between real estate and government bonds is more complex than often assumed. Some evidence of positive tail dependence was detected when high bond returns and high real estate returns coincided. The most likely explanation of this lies in the impact of interest rate shocks in both markets. This emphasises the need to be aware of the effect of leverage and capital structure on delivered real estate returns and its significance across the cycle. A shock increase (decrease) in interest rates will affect the underlying asset values negatively (positively): but gearing will magnify the impact of the value shift on returns.

[11] The modified J statistic measures the extent to which extreme values for one variable coincide with extreme values of another variable, having removed the general effects of correlation - for example, whether very low real estate returns coincide with sharp downward movements of the stock market.

6. BRIEF CONCLUSIONS AND IMPLICATIONS

The starting point of the investigation was the widely expressed concern that real estate had failed to offer diversification benefits when they were most needed. The standard approach to portfolio diversification relies on a relatively simple characterisation of risk and return relationships between assets, where individual performance is measured in terms of mean return and the variance (or standard deviation) around that return, with the relationship between assets captured by the covariance (or correlation). This assumes a particular distribution of returns – that individual returns are broadly normal and that the joint return distributions are normal. Prior evidence casts doubt on this assumption, which in turn might mean that the portfolios derived from mean–variance analysis are suboptimal.

The results of the analyses provide confirmation of that concern. Real estate returns appear to be skewed and to have 'fat tails', that is there is a higher probability of extreme returns than would be expected for a normal distribution. Moreover, there is evidence that the behaviour of real estate is linked to the equity market and to interest rates[12] and that when equity markets are performing poorly (or where real interest rates rise sharply), property exhibits strongly negative returns. In private real estate markets, there is also evidence that valuation smoothing effects are more pronounced in extreme markets such that appraisal-based performance indices may understate property market risk.

Furthermore, the relationship between real estate and other assets is far from stable over time. The influence of equities, small-cap stocks and bonds on real estate varies over time. Public real estate securities are strongly influenced by equity returns although there is a significant impact from real estate factors, an impact that became more pronounced in the global financial crisis. Longer-run analysis shows that the equity market leads the property market and that shocks in equity markets are transmitted into real estate: rapidly to listed property stocks and in a more complex and lagged, but nonetheless significant way to private real estate returns. All of this implies that the management of real estate risk in a multi-asset context is complex and that standard models may not be fully adequate for the task.

While this might seem a gloomy picture, the research has significant positive messages for real estate. The evidence from the IPF research project confirms that both private and public real estate offer diversification benefits in the mixed-asset portfolio context, as evidenced by correlations substantially lower than one. Both are influenced by the performance of financial assets, but their returns are by no means fully explained by equity and bond returns. Private real estate seems to offer greater diversification potential, but this has to be set against concerns over the robustness of data and the practical issues and obstacles associated with investment in the direct market. Thus, inclusion of real estate in a mixed-asset portfolio is likely to improve the risk-adjusted performance of that portfolio.

Furthermore, while there is evidence of tail dependence in public real estate – in particular negative tail dependence with equity returns – this seems largely confined to high-frequency data. This finding may be of particular relevance to funds and portfolios which must deal with a continuous flow of funds for investment and redemption and which must rebalance frequently. However, when daily returns are aggregated to weekly, monthly or quarterly returns, much of the tail dependence effects disappear. This is not to say that investors should not be concerned with the risks of the coincidence of negative equity and property market returns, but some of the fears that there are no diversification benefits in extreme markets seem exaggerated.

[12] It would have been concerning had the research found no link to equity markets and, in particular, to interest rates, as that might imply that property pricing was somehow disconnected with economic fundamentals.

6. BRIEF CONCLUSIONS AND IMPLICATIONS

In summary, the evidence from the IPF research project suggests that a model of risk management that relies solely on a mean–variance approach and on the assumption of stable relationships over time is unlikely to capture adequately the risks of investment in real estate markets in multi-asset portfolios. There are complex and time-varying relationships between real estate and other asset classes; real estate returns are not normal and there is a higher than expected risk of strong negative shocks in real estate, shocks that are likely to coincide with difficult capital market conditions. Nonetheless, the evidence from this project is that real estate does continue to offer diversification benefits in the mixed-asset portfolio, albeit less diversification than suggested by oversimplified approaches. The future challenge is to develop risk analysis and risk management tools and techniques that recognise these complex and shifting relationships, yet are intuitive and have demonstrable practical application.

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