The Case for Property in the Long Run: A Cointegration Test

by

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Abstract

The benefits of property in the mixed asset portfolio has been the subject of a number of studies both in the UK and around the world. The traditional way of investigating this issue is to use MPT with the results suggesting that Property should play a significant role in the mixed asset portfolio. These results are not without criticism and generally revolve around quality and quantity of the property data series. To overcome these deficiencies this paper uses cointegration methodology which examines the longer term time series behaviour of various asset markets using a very long run desmoothed data series. Using a number of different cointegration tests, both pair-wise and multivariate, the results show, in unambiguous terms, that there is no contemporous cointegration between the major asset classes Property, Equities and Bonds. The implications of which are that Property does indeed have a risk reducing place to play in the long-run strategic mixed-asset portfolio. A result of particular relevance to institutions such as pension funds and life insurance companies who would wish to hold investments for the long-term.

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Introduction

The standard tool for investigating the importance of an asset in a mixed-asset portfolio is Modern Portfolio Theory (MPT). It is used to determine the mixed portfolio of assets which achieves the highest level of return for a given level of risk. Using this approach, a number of studies in the UK have tried to evaluate the appropriate weight for Property in the mixed-asset portfolio (see Sweeney, 1988, Richard Ellis, 1990, Baring, Houston and Saunders (BHS), 1995, MacGregor. and Nanthakumaran, 1992 and Byrne and Lee 1995).

The previous studies, however, can be criticised on a number of grounds. First the historic property series used are relatively short. Secondly, most measures of Property return are appraisal rather than market based, and there is a strong view that as a consequence the volatility of property returns has been considerably underestimated (see Geltner, 1993). This leads to a lowering of the individual risk of property as measured by the standard deviation, but also a more favourable portfolio risk in comparison with other assets. Finally, the analysis of the case of property in the mixed-asset portfolio as essentially relied on short-run correlation relationships between the assets. Such short-term benefits, however, may be spurious if the asset classes are subject to the same economic forces and will eventually adjust back to some long-run equilibrium. That is if property is integrated with the other two assets its perceived diversification benefits based on short-run statistics can not justify the case for property in the long-run strategic portfolio. Therefore the long-run characteristics of property compared with the other asset classes, equities and bonds needs to be assessed.

This paper, therefore, tackles the problem in a different way to try and overcome these objections. First a long run desmoothed time series is used for the property data. The data used cover the period 1921 to 1996 for the three main asset classes Property, Equities and Bonds. The data therefore covers many cycles in the financial markets, and the economy in general, and could be said to represent the long-run characteristics of the assets in question. Secondly the long-run characteristics between the series are investigated rather than concentrating on the short-run perceived benefits.

Methodology

The specific model used in this study is cointegration. This statistical concept introduced by Granger (1983), Granger and Weiss (1983) and Engle and Granger (1987) has received wide attention and is beginning to be applied to test the validity of various theories and models.

Cointegration is a property possessed by some non-stationary time series data. In this concept, two variables are cointegrated when a linear combination of the two is stationary, even though each variable is non-stationary. In particular, if we if consider two time series, X and Y that are non-stationary, conventionally one would expect that a linear combination of two the variables would also be non-stationary. In order to avoid the problem of non-stationarity it is necessary to make use of first (or higher) differentiated data. Such differencing, however, may result in a loss of low frequency information or long-run characteristics of the series data. However, Engle and Granger (1987) showed that, if there is an equilibrium relationship between such variables, then for this relationship to have any meaning a linear combination of these variables the disequilibrium error should fluctuate about zero i.e. should be stationary. Therefore, if Y, and X, are cointegrated, then there exists a number *d*, such that:

$$C = Y - dX \qquad (1)$$

is stationary, where the parameter *d* is the cointegrating parameter that links the two time series together. Further, the relationship Y = *d*X is considered to be a long-run, or 'equilibrium', relationship suggested by economic theory. Under such circumstances these markets are said to be cointegrated. In contrast, lack of cointegration implies that the aforementioned variables have no link in the long-run.

If two, or more series, are cointegrated, then there exist common factors that affect both and their permanent or secular trends, and so the series will eventually adjust to equilibrium. The implications for diversification are that even if, in the short-term the covariance between two series indicates portfolio benefits, in the long-run such benefits are spurious as the two series will eventually adjust to an equilibrium relationship. Also there are in reality fewer assets available to portfolio holders than is evident from a count of the assets available. As two or more of the asset classes are substitutes for each other. Thus, in the case of cointegrated markets, the benefits of diversifying across such markets would appear to be limited. Finding that Property is cointegrated with Equities and/or Bonds would therefore imply that assets from both areas should not be held as part of a portfolio. Unless, as Byers and Peel (1993) point out, the cointegrating regression coefficient is less than one. In such circumstances a portfolio which includes different asset classes can still have a lower risk than one concentrated in a particular asset. Thus cointegration does not preclude the benefits of diversification as long as the cointegrating coefficients are low.

Hence, the existence of an equilibrium relationship between two or more variables, assuming that they all are integrated individually to the same degree, requires that the cointegration between them is of a lower degree. That is if both X and Y are stationary I(1) the cointegration vector must be stationary I(0). However, if X and Y are integrated to different degrees, there will not be any parameter *d* that satisfies Equation (1). Thus a long-run relationship implies the requirement that the two variables should be (i) integrated to the same degree and (ii) a linear combination of the two variables should exist which is integrated to a lower degree than the individual variables.

Testing for cointegration involves two steps.

1. Determine the degree of integration in each of the series, a unit root analysis.
2. Estimate the cointegration regression and test for integration.

Unit Roots

A two variable cointegration test requires that the variables be integrated of order one. In other words the series data should be stationary only in their first differences, and not in levels.

A number of alternative tests are available for testing whether a series is stationary or not, the Augmented Dickey-Fuller (ADF), Dickey and Fuller (1979), as well as the Phillips-Perron (PP) test developed by Phillips (1987) and Phillips and Perron (1988). The PP tests are based on the following ADF regression, and the critical values are the same as those used for the ADF tests:

$$\Delta X_t = \lambda_0 + \lambda_1 X_{t-1} + \lambda_2 T + \sum_{i=1}^{n} \Psi_i \Delta X_{t-i} + \varepsilon \qquad (2)$$

where Δ is the difference operator, X is the natural logarithm of the series, T is a trend variable, λ and Ψ are the parameters to be estimated and ε is the error term. The PP unit root test is utilised in this case in preference to ADF unit root tests for the following reasons. First the PP tests do not require an assumption of homoscedasticity of the error term (Phillips, 1987). Secondly, since lagged terms for the variable of interest are set to zero there is no loss of effective observations from the series (Perron, 1988), which is especially useful if the number of data points is limited. The PP unit root test corrects the serial correlation and autoregressive heteroscedasticity of the error terms by a technique called the Bartlett window. This aims at providing unit root tests results that are robust to serial correlation and time-dependent heteroscedasticity of errors.

In both the PP and ADF unit root tests the null hypothesis is that the series is non-stationary and this is either accepted or rejected by examination of the t-ratio of the lagged term X_{t-1} compared with the tabulated values. Note that the t-ratio values are not those from the student t-distribution, but rather, based on Monte Carlo simulations as the student t-distribution is ???? in the face of lagged terms, ??? and ??? (19??). If the t-ratio is less that the critical value the null hypothesis of a unit root (i.e. the series is non-stationary) is accepted. If so the first difference of the series is evaluated by equation (2) and if the null hypothesis is rejected the series is considered stationary and the assumption is that the series is integrated of order one I(1). Critical values for this t-statistic are given in Mackinnon (1991).

Cointegration

Assuming that each series has the same number of unit roots, the cointegration test can commence. Engle and Granger (1987) proposed seven tests for examining the hypothesis that two time series are not cointegrated. In cointegration tests, the null hypothesis is non-cointegration. Only two are used here both based on the using an OLS regression in the following form:

$$Y = \alpha + \beta X + \mu \qquad (3)$$

where β is the estimator for the equilibrium parameter, *d*; α is the intercept; and μ is the disturbance term. The first of the two tests of cointegration is based on the Cointegrating Regression Durbin-Watson (CRDW) statistic. As a simple 'rule of thumb' for a quick evaluation of the cointegration hypothesis Banerjee et al (1986) proposed that: if the CRDW statistic is smaller than the coefficient of determination (R^2) the cointegration hypothesis is likely to be false; otherwise, when CRDW> R^2, cointegration may occur. Alternatively the CRDW statistic can be evaluated against critical values developed by Engle and Granger (1987), if the CRDW statistic exceeds the critical value, the null hypothesis of non-cointegration is rejected. Suggesting that the series are not cointegrated.

The second test of cointegration is based on testing the stationary of the error terms from equation (3). That is the following the same procedure for unit root testing as used in equation (2). Where the equation to be tested now is:

$$\Delta\mu_t = \lambda_0 + \lambda_1\mu_{t-1} + \lambda_2 T + \sum_{i=1}^{n} \Psi_i \Delta\mu_{t-i} + \varepsilon \qquad (4)$$

where λ and Ψ are the estimated parameters and ε is the error term. The number of lags (n) chosen in equation (3) should be sufficient to ensure that the error term ε, is white noise. The choice of n is based on the modified Lagrange Multiplier (LM) statistic since Kiviet's (1986) simulations results indicate that the modified LM statistic test is more 'relatively invariant to sample size, order of serial correlation, true coefficient values, and redundant regressors' in models involving lagged dependent variables. The test for cointegration involves the significance of the estimated λ_1 coefficient. Again the null hypothesis is that the error terms are non-stationary and acceptance of this hypothesis indicates that the series under investigation are not integrated. If the t-statistic on the λ_1 coefficient exceeds the critical value, the μ residuals from the cointegration regression equation (3) are stationary and the variables X and Y are cointegrated. Critical values for this t-statistic are given in Mackinnon (1991).

Multivariate Cointegration

It may be, however, that the asset are not integrated on a pair-wise basis but in some multivariate way. That is the assets are cointegrated jointly. In order to test for higher orders of cointegration two approaches were adopted.

The first test follows Coleman (1990) in which the multiple cointegrating regression is estimated as:

$$X_i = \alpha + \beta_j X_j + \beta_k X_k + \eta \qquad (5)$$

Equation 5 is again estimated by OLS, and test whether the cointegrating residual, η (i.e. a linear combination of the variables X) is stationary. If the residual series rejects the null hypothesis of no cointegration the assets are jointly integrated. Failure to reject the null hypothesis again indicates that the asset classes' permanent or secular trends are driven by different forces. Again Equation 4 can be used to test for stationarity, though as Engle and Granger (1987) point out, different critical values must be used as the null is rejected more often than the nominal test size suggest. The 1% critical value was, therefore, chosen to reduce this problem.

The second test uses the approach of Johansen (1988) and Johansen and Juselius (1990). This test procedure consists of estimating a vector autoregressive (VAR) model which includes differences as well as levels of the nonstationary variables. That is:

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \ \ldots\ldots\ + \Gamma_{k\text{-}1} \Delta X_{t-k+1} + \pi X_{t-k} + \varepsilon \qquad (6)$$

where the ε are Gaussian random variables, and Γ_i and π are matrices of parameters estimated using OLS as described in Johansen (1988). The component πX_{t-k} ?? in equation (6) produces different linear combinations of levels of the time series X_t as such the matrix π contains information about the long-run properties of the system described by the model. For example if the rank of the matrix of coefficients π is 0, then no series of the variables can be expressed as a linear combination of the remaining series. This indicates that there does not exist a long-run relationship among the series in the VAR model as a test of cointegration a rank of 0 means integration is rejected. On the other hand, if the rank of the coefficient matrix π is 1, or greater than 1, then there exists one or more cointegrating vectors. This indicates a long-run relationship, or that the series exhibits significant evidence of behaving as a cointegrated system.

In a multivariate test of cointegration we are interested whether there exists at least one cointegrating vector. In other words, whether the rank of the coefficient matrix is at least 1. Thus the null of no cointegration is rejected, if the rank of the matrix is greater than or equal to 1.

Johansen (1988) has proposed two statistics which can be used to evaluate the rank of the coefficient matrix, or the number of cointegrating relationships. The one used here is the a likelihood ratio test of the null hypothesis that the number of cointegrating vectors is r versus the alternative r+1 vectors. In this case, our null hypothesis is that the number of cointegrating vectors equals 0.

Previous Research

In the context of real estate data only a few studies have investigated the issue of market integration. The studies concentrated on investigating whether real estate markets are segmented from capital markets with only one study examining the segmentation or integration in international real estate securities. For example, Liu et al (1990) examined the extent to which commercial property markets are segmented from capital markets in the context of the Capital Asset Pricing Model (CAPM). Using the approach of Jorian and Schwartz (1986), the authors find evidence of segmentation that suggests commercial real estate markets are driven by different economic forces than stock markets. The results, however, were contingent on whether the real returns were calculated from appraisal based data or imputed sales values. The question as to whether commercial real estate markets and capital markets are integrated or segmented therefore was unclear. Fu et al (1994) applied Granger (1969) causality tests to quarterly data of residential property prices and the Hong Kong stock market. The authors found that changes in the stock market led changes in house prices, but not vice-versa. Fu et al argue that the results appear to support market segmentation. Wlison et al (1996) investigated whether of the Australian real estate and equity markets are integrated based on data from apartments and the Sydney stock market. The authors conclude that on balance that results support the view that real estate and stock markets are segmented. Finally Wilson and Okunev (1996) report that cointegration tests showed an absence of any long-run relationship between securitised property markets and domestic equity markets in the USA, the UK and Australia. In general then all these studies tend to show, with some reservations as to the quality of the real estate data, that real estate markets are segmented from capital markets. Whether the same can be said for the UK for over the last 75 years is the subject of the next sections.

Data

A number of sources of property returns are available in the UK covering different time periods, sample sizes and level of disaggregation (Morrell, 1991, Society of Property Researchers (SPR), 1993 and Gordon, 1991). None of them are ideal for the present study although the Investment Property Databank (IPD) Annual data series is generally employed in studies, see for example Byrne and Lee (1995). Unfortunately the IPD Annual series only covers the period 1971-1996, that is 26 observations, a sample size which may be considered insufficient for testing cointegration. An alternative would be to use quarterly data which is available back to 1977 from Jones Lang Wotton (JLW). Research by Giliberto (1990), Graff and Cashdan (1990), Wheaton and Torto (1990) and Gyourko and Keim (1992), however, suggests that in property investment analysis, the use of annual data is preferred to quarterly or monthly because of inconsistencies, lags and seasonality in the appraisal based data.

The data series used is drawn from two sources. First property returns covering the period 1921 to 1970 are taken from Scott (1996). These returns based on three sets of data. The first period from 1920-48 based on the returns of prime shops. The second period from 1949-1955 based on the annual property returns of a small investment institution with an average of 50 properties in its portfolio over these years. Finally data for the period from 1956-1970 complied from the records of two large institutional investors holding property valued at almost £74 million in 1956 rising to just over £395 million by 1970. Unfortunately data for the period from 1939 to 1946 is not available.

The second source of property returns covering the period from 1971-1996 is the IPD Long Term Index (IPD, 1997), as it is *de facto* the standard for comparing the performance of Property against the other asset classes, SPR (1993). This gives 68 data points covering a number of cycles in the property market and the economy and of a sufficient length for cointegration analysis. The comparable figures for equities and bonds are those from BZW (1997). The summary statistics of which are shown in Table 1.

Table 1 Nominal and Real Risks and Returns For Property, Equities and Bonds 1922-38 and 1947-1996

	Nominal			Real		
	Property	Equities	Bonds	Property	Equities	Bonds
Average Returns	9.64	15.22	7.00	5.39	11.04	2.43
Standard Deviation	9.43	26.49	13.79	10.43	26.25	14.74
Coefficient of Variation	0.98	1.74	1.97	1.94	2.38	6.06
Serial Correlation	0.35	-0.13	0.01	0.35	-0.13	0.14

Source: Scott (1996) and BZW (1997)

As can be seen Property offered higher nominal returns than Bonds but less than Equities, in line with previous studies. Also, in line with previous work, the risk of Property, as measured by its standard deviation, is considerably less than that for either Bonds or Equities. As a consequence the coefficient of variation, the standard deviation divided by the mean, is less than one for property, whereas the other asset have coefficients of variation greater than one. Even using real returns, the individual investment characteristics of property are still very attractive. The significant positive serial correlation of Property returns either nominal or real, however, suggests that the appraisal based property data are not truly representative of investor experience.

As has been suggested earlier, the use of such appraisal based data leads to smoothing in the return series, and to an understatement of the 'true' risk of Property. Smoothing results principally from the way in which appraisals are undertaken. Survey results indicate that valuations in the UK are mainly based on comparable evidence (Crosby 1990), which are themselves based on previous valuations. This tendency to recycle valuations has the effect of incorporating previous prices in the current return. The consequence of this is that if the appraisal series is sufficiently long, the Mean return is likely to represent an unbiased estimate of the 'true' return of the Index. The risk of the Property returns will however be biased downwards and the returns series is likely therefore to exhibit strong positive autocorrelation (Brown 1991) due to inertia in the system, unlike Equities and Bonds. As a consequence Geltner (1993) asserts that since appraisal based property data understates the true volatility of returns, they should only be used after correcting for appraisal bias when assessing the 'Case for Property' against Equities and Bonds.

In order to bring the Property return series into line with Equities and Bonds it has been suggested that the effects outlined above can be removed, by taking into account the autoregressive process exhibited by the data. With various approaches for the removal of this smoothing effect have been and continue to be proposed (see

Fisher et al. 1994). Given the different ways in which the desmoothed series can be calculated, there is no absolute way of determining whether one approach is more appropriate than another. Initially a number of different approaches were therefore adopted as suggested in the literature, with similar results. The final approach adopted was that of Geltner (1993) as it makes no assumptions about the efficiency of the property market. Which recovers the underlying or true property series by applying the following reverse filter:

$$R_t^u = \frac{(R_t^* - (1-\alpha)R_{t-1}^*}{\alpha} \qquad (6)$$

where R_t^u is the unobserved market return, R_t^* is the observed appraisal based value and α is a parameter between 0 and 1. If no smoothing is present in the returns then α is equal to 1. The standard deviation of the desmoothed data was then compared with that of the Equity data which showed that the market property data risk was approximately 50% of that of the equity market. The results comparable with those found by Stevenson (1997) and Newell and MacFarlane (1994) and Barkham and Geltner (1994) for different series covering different time periods and in different countries. The results of these calculations are summarised in Table 2.

Table 2: The Risk and Return Characteristics of Nominal and Real Desmoothed Property Data

	Appraisal Based		Desmoothed	
	Nominal	Real	Nominal	Real
Average Returns	9.64	5.39	9.91	5.48
Standard Deviation	9.43	10.43	13.57	14.63
Coefficient of Variation	0.98	1.94	1.37	2.67
Serial Correlation	0.35	0.35	0.02	0.11
Correlation with				
Equities	0.249	0.241	0.359	0.359
Bonds	0.185	0.309	0.272	0.368

The table clearly shows that desmoothing the property data significantly increases the standard deviation of returns without materially affecting the average returns. As a consequence the coefficient of variation is now above one for the nominal data and more in line with the results of the other asset classes. The correlation of Property with the other assets as also changed markedly from that of the smoothed data. Property is now much more positively correlated with Equities and Bonds, although still less so than between Bonds and Equities (0.58 nominally and 0.57 in real terms). This indicates that Property would still remain attractive to an MPT optimiser. The desmoothing process can also be seen to have removed the significant first order serial correlation (0.35) present in the original returns data. This suggests that desmoothed Property returns are now more like market valuations, as in the case of Equity and Bond returns. Although these returns should not be taken as actual transaction values, such prices would also reflect the liquidity of the market, and are probably reasonable estimates.

Empirical Results

1. Unit root tests

As outlined above cointegration require the data series in each asset class to be integrated to the same order and the existence of a linear combination of the series which is integrated to a lower order than the individual series. That is, the number of times that the series must be differenced to achieve stationarity is the same across all the data Perman (1991).

Following the work of Perron (1988) and Nelson and Plosser (1982), we analyse the logarithm of the price series instead of the level to account for the fact that there is a tendency for the dispersion of the series to increase with the absolute level (Perron, 1988). This follows the standard practice of unit root tests literature (see Baillie and Bollerslev, 19?? and Corbae and Outliaris, 19??). Both the level and first difference of each property series were tested, the results presented in Table 3.

Table 3: Results of the PP tests

	Level		Difference	
	Nominal	Real	Nominal	Real
Equity	-1.602	-3.245	-8.833	-8.590
Bonds	-0.033	-1.627	-8.377	-7.597
Property	-1.818	-3.095	-8.098	-7.486

The results of the unit root tests show that all series were non-stationary in levels (critical value -4.101 (1%) Mackinnon, 1991), but stationary in first differences. The 1% significance level deemed to be more appropriate in testing for a unit root as the critical values of the t-statistics simulated by Fuller (1976), Gulkey and Schmidt (1989)and Mackinnon (1991) can vary markedly. The t-statistics for all series are greater (less negative) than the critical values in levels leading to the acceptance of the null hypothesis of non-stationarity. Only in the case of the real Equity return series is stationary accepted, (critical value at the 10% significance level -3.166). Whereas the first difference results show that the null hypothesis can be easily rejected at the 1% significance level and hence acceptance that all the series are stationary when first differenced. The results show that all the series tested are not stationary in (log) levels but are stationary after being differenced once, fulfilling a necessary condition for cointegration. All the series are therefore assumed to be integrated of order one.

2. Pairwise and Multivariate Cointegration Tests

The first test of cointegration then is to estimate equation (3) and test the significance of the (CRDW) statistics for each pairwise comparison both nominal and real. The results of which are shown in Table 4 together with the PP tests statistics based on the residuals from equation (3).

Table 4: Pairwise Cointegration Results

		R-Sq.	CRDW	PP test
Property V's	Nominal	0.976	0.356	-2.626
Equities	Real	0.883	0.342	-2.304
Property V's	Nominal	0.855	0.084	-0.345
Bonds	Real	0.037	0.067	-2.976
Bonds V's	Nominal	0.885	0.079	-0.398
Equities	Real	0.901	0.418	-2.739
Equities V's	Nominal	0.885	0.075	-0.555
Bonds	Real	-0.003	0.063	-2.929

Using the simple 'rule of thumb' proposed by Banerjee et al (1986) in almost every case the CRDW statistics are below their corresponding coefficients of determination (R^2), cointegration between the asset pairs is therefore unlikely. Only in the case of Property versus Bonds and Equities versus Bonds, both in real terms, is there an indication that cointegration may be present. Engle and Granger (1987), however, point out that this test lacks power and should only be used for a quick approximate result. This conclusion supported by a comparison of the CRDW statistics against the critical values of ???? at the 5% and 1% levels respectively (Engle and Granger, 1987), which indicates the acceptance of the null hypothesis of no cointegration. While all the t statistics of the PP test are all above (i.e., less negative) than the critical value of -4.099 that would call for rejection of the null hypothesis of non-cointegration at the one percent level. The results of the CRDW and PP test show the rejection of cointegration between all the assets on an individual basis.

Tables 5 and 6, summarise the multivariate tests of the no cointegration hypothesis for Property, Equities and Bonds. The tests focus on whether the returns, both nominal and real for each of the assets classes are jointly cointegrated. The results for Equation 5 for both nominal and real data, in Table 5 in all but one asset (Bonds versus Property and Equities) fail to reject the null hypothesis of no-cointegration based on the CRDW Test. The PP test in comparison fails to reject the null hypothesis in all cases, indicating a lack of integration between the asset classes even in the multivariate case.

Table 5: Multivariate Cointegration Tests

		R-Sq.	CRDW	PP test
Property V's	Nominal	0.976	0.365	-2.715
Bonds and Equities	Real	0.901	0.418	-2.739
Bonds V's	Nominal	0.884	0.088	-0.613
Property and Equities	Real	0.079	0.155	-1.918
Equities V's	Nominal	0.981	0.356	-2.808
Property and Bonds	Real	0.897	0.411	-2.748

The results in Table 5 are confirmed by the Johansen likelihood ratio test shown in Table 6. The likelihood statistics are all well below the 5% and 1% significance level values indicating the acceptance of the null hypothesis. In other words in both the nominal and real terms, the rank of the coefficient matrix of the VAR model is 0 rather than greater than or equal to 1 indicating the number of cointegrating vectors is 0 and rejecting any long-run relationship between the asset in the system.

Table 6: Johansen Test for the Number of Cointegrating Vectors

		Number of Cointegrating Vectors		
		None	At Most 1	At Most 2
Likelihood Ratio Test	Nominal	19.95	8.97	1.03
	Real	12.85	3.20	1.08
Critical Values	5%	29.68	15.41	3.76
	1%	35.65	20.04	6.65

The results confirming those based on the simply pair-wise tests above and indicate that Property, Equities and Bonds are not cointegrated contemporaneously, in either nominal or real terms. In other words Property does indeed provide significant diversification benefits and is a uniquely effective diversifier, because the economic variables the cause fluctuations in Property returns are not the same as the variables that cause fluctuations in the other two assets. How effective Property is as a diversifier can be gauged by the constructing a number of mixed-asset portfolios, which is done in the next section.

The Case for Property

Rather than calculating the whole efficient frontier, a number of optimal portfolios were identified, which could indicate the likely allocation property should have in the long-run mixed asset portfolio.

The first group of portfolios are all *ex-post* optimal (tangency) portfolios, identified by the following maximisation problem:

$$\text{Max } \theta \equiv \frac{\overline{R}_p - R_f}{\sigma_p} \quad (1)$$

Where:

$\overline{R}_p$ = the expected return of portfolio p,

R_f = the risk - free rate of return,

σ_p = the standard deviation of the portfolio.

The weights in these portfolios then are the ones offering the highest *ex-post* mean return per unit risk. Note that θ in the above formulation is, in fact, the *ex-post* Sharpe (1994, 1996) performance measure. The composition of such a tangency portfolio, as shown by Tobin (1958), is independent of the investors' preference structure. Two different risk-free were used. First R_f was set to zero. The second approach using the average risk free rate over the period of analysis.

Two other portfolios were also identified. The first the minimum variance portfolio (MVP), which in previous studies has contained a high portfolio allocation from Property. Second a naive 60/40 Equity Bond portfolio, to act as a benchmark of comparison. The analysis conducted on the pre and post war periods and for the data overall. The results presented in Table 7.

The first notable feature of Table 7 is the very high allocation given to property in the optimal portfolios, especially in the post war period, of not less than 57%. Property even in the pre war period receiving an allocation of not less than 24%. Overall the allocation to property never falling below 50%. Such high allocations still achieved after desmoothing the data to purge it of appraisal bias.

The second feature to notice in Table 7 is the superior performance achieved from adding property to the mixed asset portfolio, compared with the naïve 60/40 equity bond portfolio. For example, the long run portfolio based on the average risk free rate over the whole period has a return of 12.48%, which is 46 basis points higher than that of the 60/40 equity bond portfolio, but a risk of only 16.36% per annum which is 327 basis points less than the naive equity bond portfolio. Similar comparison can also be made in the pre and post war periods. In the post war period for example the 60/40 equity bond portfolio achieved a return of 12.60% and a risk of 21.09%. In comparison the optimal portfolio based on the average risk free rate over this period had a return of 13.01% and a risk of only 15.79%.

Table 7: Optimal Long Run Portfolios

Portfolio	Mean Return	Standard Deviation	Weights Property	Weights Equity	Weights Bonds
Pre War					
Average Risk Free	10.32	14.36	24	59	17
Risk free = Zero	8.85	11.99	29	35	36
MVP	6.66	10.27	37	-	63
60/40 Equity Bond	10.33	14.94	-	60	40
Post war					
Average Risk Free	13.01	15.79	62	38	-
Risk free = Zero	11.04	12.40	76	11	13
MVP	9.24	11.03	57	-	43
60/40 Equity Bond	12.60	21.09	-	60	40
Overall					
Average Risk Free	12.48	16.36	54	46	-
Risk free = Zero	10.15	12.36	65	15	20
MVP	8.41	10.91	51	-	49
60/40 Equity Bond	12.02	19.63	-	60	40

The results in Table 7 while not definitive, given the *ad hoc* nature of any desmoothing process, strongly suggest that property has a major role to play in the long-run mixed asset portfolio. Furthermore, the allocation to property, even after desmoothing the data, indicates a higher weighting to Property than is the norm for most institutional investors. The fact that property doesn't have a larger allocation must be down to the perceptions of institutions as to the illiquidity of real estate and the high management costs of running a property portfolio (Gooch & Wagstaff, 1990 and Rydin, Rodney and Orr, 1990). Rather than the risk and return characteristics of property per se.

Conclusions

This study has examined the 'Case for Property' in the mixed-asset portfolio that is generally investigated by the use of MPT. The use of MPT, however, can be questioned in on a number of grounds. First the Property data used is appraisal based and as such is not regarded to be as representative of 'true' market based results. Secondly studies using direct Property data are typically based on only a few time series data points. Finally most studies rely on the short-term based correlation (covariance) values, between the assets classes, as the justification for suggesting a larger place for Property in the mixed asset portfolio.

The present paper tries to overcome these objections by using a desmoothed Property data series from 1921-1996 and a methodology that explicitly tests for any long-run equilibrium relationships between the various asset classes. Using a number of different cointegration tests, both pairwise and multivariate, the results show, in unambiguous terms, that there is no contemporous cointegration between the major asset classes Property, Equities and Bonds, in either nominal or real terms. In other words Property does provide significant diversification benefits and is a uniquely effective diversifier, because the economic variables the cause fluctuations in Property returns are not the same as the variables that cause fluctuations in the other two assets. The implication of this is that Property does indeed have a risk reducing role to play in the mixed-asset portfolio! A result in line with previous research finding that holdings in Property can be justified in a portfolio context!

What does drive Property markets and to what extent these 'drives' differ those which explain the Equity and Bond markets should prove a fruitful area of future research, some of which as already been started in the UK with the report by the Royal Institution of Chartered Surveyors (1994) into property cycles.

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