EVALUATING THE SHARPE PERFORMANCE OF THE AUSTRALIAN PROPERTY INVESTMENT MARKETS

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ABSTRACT

The Sharpe performance is a commonly recognised measure for comparing the risk adjusted returns of competing investment classes. On the surface, Australian property investment markets, display good Sharpe performances with relatively solid returns and low risk profiles. However, the Sharpe performance formula neglects two important features typically displayed by appraisal based property returns: non-normality and autocorrelation. These both can lead to an underestimation of the true risk of direct property and so an overestimation of the associated Sharpe performance. On applying a number of adjustments to the traditional Sharpe ratio, this research examines the joint effects that autocorrelation and non-normality have on the risk-adjusted performance of direct property in comparison with shares and bonds. The results indicate that overall direct property still maintains its attractiveness and ranking even after the effects of non-normality and autocorrelation are taken into account.

Keywords: Property returns, Sharpe ratios, autocorrelation and non-normality

INTRODUCTION

Leading investment strategies are commonly based on performance measures that accurately capture risk and return profiles. For many, the Sharpe performance measure is utilised as the risk-adjusted return benchmark, as it provides a measure of reward per unit of risk. For direct property, with relatively stable returns, the Sharpe performance compares favourably to completing share and bond investment classes. However, as Brown and Matysiak (2000) noted, appraisal based property data commonly displays non-normality and autocorrelation, both of which lead to an underestimation of the true risk of direct property and so an overestimation of the associated Sharpe performance.

This research takes a three-step approach to examine the significance of non-normality and autocorrelation on the Sharpe performance of the Australian property investment markets:

i. The research mitigates the impact autocorrelated returns have on Sharpe performance by using de-smoothed property returns.

ii. For the non-normality in the data, the standard deviation in the traditional Sharpe ratio is replaced with a modified value-at-risk (MVaR) formula, which explicitly accounts for any skewness and excess kurtosis in the return distribution.

iii. The adjusted modified Sharpe performance is then calculated on the removal of the joint effects that autocorrelation and non-normality have on the risk-adjusted performance.

To identity the changes at each stage, the Sharpe performance of the individual Australian property investment markets and completing share and bond investment classes were specified and ranked. Lastly, a Spearman correlation test is applied to the original and modified Sharpe performance data.

Following this introduction, section two describes the Australian property investment market and section three details the data used in the empirical investigation. Section four examines the traditional Sharpe performance of the property in comparison with three alternative financial securities; shares and bonds and securitised property. Section five analyses the issues in connection with the property returns and Section 6 presents a number of amended Sharpe ratios used in the analysis designed to examine the effects of autocorrelation and non-normality in the return series. The last section provides the concluding comments.

AUSTRALIAN PROPERTY INVESTMENT MARKET

Locations of Australian investment grade properties are predominately in major urban areas. These are along the eastern seaboard: Queensland, New South Wales and Victoria, and in Western Australia – surrounding Perth, the State capital. This is illustrated when looking at the location of investment grade properties across the Australian States, see Table 1.

Table 1: Australian states: investment grade property: December 2007

State	Office		Retail		Industrial	
	Area sqm	Value $b	Area sqm	Value $b	Area sqm	Value $b
New South Wales	6,097,000	48	5,497,000	34	11,903,000	24
Victoria	4,044,000	19	3,377,000	20	9,794,000	13
Queensland	2,508,000	14	4,380,000	22	7,630,000	13
Western Australia	1,339,000	10	2,175,000	10	3,924,000	1
Sub Total	13,988,000	91	15,429,000	86	33,251,000	51
Australian Total	16,079,000	99	17,474,000	96	37,525,000	57

Source: Higgins *et al* (2008)

Table 1 details the size and value of the core Australian investment grade property markets. The main four Australian States (Queensland, New South Wales, Victoria and Western Australia) have AU$228 billion, being over 90% of the AU$252 billion Australian investment grade property market. New South Wales is by far the largest State, with in excess of 40% of all Australian core investment grade properties.

DATA

For this study, the total annual return data is sourced from the Investment Property Databank (IPD) Property Investors Digest and covers the 1985 to 2008 period, a total of 24 data points. The IPD/PCA indices are based on the individual property data property made up 1,077 properties valued at AU$88.4 billion as at the end of December 2008. The selected property data covers the leading investment grade office, retail and industrial property markets of the four main Australian States (Queensland, New South Wales, Victoria and Western Australia). This represents as close as possible the total returns for institutional investors with investment grade properties located across Australia's main property markets. The data index construction combines current and past IPD/PCA property market indices to produce the 12 property investment markets.

In addition to the property investment markets, alternative assets are represented by the annual returns of shares (as measured by the ASX All Ordinaries index), real estate securities (as measured by the S&P/ASX REIT 300 index) and fixed interest securities (as measured by the CBA Bond: Greater than 10 Years index).

SHARPE PERFORMANCE

The most widely used measure of risk-adjusted performance in financial analysis is the reward-to-variability ratio or Sharpe ratio (Sharpe 1966 and 1994). Indeed, in the financial literature, the use of Sharpe ratio is almost ubiquitous as the foremost measure of risk-adjusted performance (Bernstein 2007, Travers 2004). This simple statistic uses the average excess returns of an asset (beyond a defined risk-free rate) relative to its volatility, as measured by its standard deviation:

$$\textbf{Sharpe Ratio} = \frac{R_p - R_f}{\sigma_p} \qquad (1)$$

where:

σ_p = standard deviation of asset p
R_p = return of fund p
R_f = risk free rate of return (90 day bank bills etc)

A high Sharpe performance is preferred with anecdotal evidence that with diversification, fund managers often have a target benchmark of one (Bernstein 2007).

Table 2: Sharpe performance of property, bonds and equities: annual data 1985 to 2008

	Asset Class	Mean	Rank	SD	Rank	SR	Rank
Prime Office	Sydney CBD	9.63	14	13.35	12	0.11	14
	Melbourne CBD	9.06	15	10.78	9	0.08	15
	Brisbane CBD	10.23	13	8.98	8	0.23	11
	Perth CBD	11.18	11	15.56	13	0.19	12
Retail	NSW	13.21	4	6.46	3	0.78	3
	Victoria	12.72	6	7.15	5	0.64	5
	Queensland	13.91	2	5.81	1	0.99	1
	WA	14.90	1	6.82	4	0.98	2
Industrial	Sydney	11.41	9	7.75	7	0.42	7
	Melbourne	13.00	5	7.39	6	0.65	4
	Brisbane	11.40	10	6.41	2	0.50	6
	Perth	12.21	8	12.96	11	0.31	9
All Ordinaries		13.24	3	20.63	15	0.25	10
A-REIT 300		10.60	12	18.33	14	0.13	13
10 year Bonds		12.30	7	11.67	10	0.35	8

Table 2 shows the property investment with the highest average returns over the 1985-2008 period was West Australia Retail (14.90%), while the worst returns were by the

prime Office sector, particularly Melbourne Office (9.06%). The property investment with the lowest risk was Queensland Retail (5.81%) with Perth Offices (15.56%) showing the highest risk.
Of the alternative asset classes, All Ordinaries provided returns above nine of the property market segments, but the risk was on average twice that of the Australian property investment market. The securitised public property market (A-REITs) was serious affected by the 2008 financial crisis with a recorded decline of 55%. This placed A-REITs in the bottom ranked quartile for both returns and risks. The fixed interest securities (bonds) market was ranked mid range for returns and Sharpe performance.

The traditional Sharpe ratio shows that all property market segments, except Offices and Perth Industrial, displayed better risk-adjusted performance than the three financial market investments. Thus, on the basis of this analysis, one could say that overall direct Australian property investments in Australia yields better risk-adjusted performance than the traditional (shares and bonds) asset classes.

ISSUES WITH THE SHARPE PERFORMANCE

While the Sharpe ratio derives its appeal from its simplicity, its theoretical foundation depends on several restrictive assumptions for it to be an appropriate measure of performance, these being:

i. Defined risk free rate
ii. Positive returns
iii. Asset returns are normally distributed
iv. No autocorrelation in the returns.

Of these four assumptions, the issues of normality and autocorrelation present the greatest challengers when assessing the performance of direct property against the alternative financial asset classes. The assumption of normality in property returns has been examined by a number of researchers in different countries (see Young *et al* 2006 for a comprehensive review). For Australia, Higgins (2008) found that property displays significant skewness and excess kurtosis and so exhibit significant departures from normality.

Non-normality investment theory argues that investors should also consider the higher moments of the return distribution in their decisions, especially the skewness and kurtosis of the data. For example, Scott and Horvath (1980) and Weisman and Abernathy (2000) showed that risk-averse investors dislike negative skewness and positive excess kurtosis (fat tails). Negative skewness and positive excess kurtosis are unattractive because they generally indicate a higher probability of large losses than is the case of normally distributed returns. However, higher moments of the return distribution are not considered in the traditional Sharpe ratio and so the risk-adjusted performance can be overstated.

Returns are not normally distributed if the higher moments (skewness and excess kurtosis) deviate from zero. The absence of normality can also be tested using the Jarque-Bera (JB) statistic. This is a simple test of normality based on the fact that a normal probability density function has skewness = 0 and excess kurtosis = 0. Under the null hypothesis of normality, the JB statistic is distributed as a α statistic with 2 degrees of freedom. Table 3 details the values of skewness, excess kurtosis, and the JB statistic for the selected data.

Table 3: Non symmetrical statistics: Australian property, bonds and equities data

	Asset Class	Skew	Rank	Kurt	Rank	JB	Prob
Prime Office	Sydney CBD	0.89	10	2.90	1	6.19	0.05
	Melbourne CBD	-0.92	11	0.99	7	3.40	0.18
	Brisbane CBD	0.20	3	0.61	9	0.01	1.00
	Perth CBD	-0.32	4	1.59	5	1.53	0.47
Retail	NSW	0.69	9	3.18	2	16.34	0.00
	Victoria	1.81	14	4.82	6	28.69	0.00
	Queensland	0.17	2	0.06	11	1.48	0.48
	WA	0.59	7	-0.28	13	2.55	0.28
Industrial	Sydney	-1.44	12	2.64	4	16.13	0.00
	Melbourne	-0.17	1	-0.50	14	0.32	0.85
	Brisbane	-0.64	8	0.54	10	2.45	0.29
	Perth	-1.51	13	3.34	3	12.35	0.00
All Ordinaries		-0.51	5	0.90	8	0.16	0.92
A-REIT 300		-1.95	15	6.67	15	0.29	0.87
10 year Bonds		-0.57	6	-0.05	12	1.12	0.58

Table 3 shows, for property, only the Perth Industrial market displays the unattractive feature of negative skewness and positive excess kurtosis. In part this is due to the Perth Industrial market being nearly twice as volatile as the other industrial property markets. Interestingly, the negative skewness and positive excess kurtosis combination also occurs for securitised real estate (A-REITs). On a positive note, six of the property market segments show the attractive feature of positive skewness, although the kurtosis readings were mixed with only NSW Retail displaying a fat tail (leptokurtosis). Thus, on the basis of the JB statistic, the assumption of normality is rejected for four property markets: NSW Retail, Victoria Retail, Sydney Industrial and Perth Industrial.

AMENDED SHARPE PERFORMANCE

As Lee (2008) noted, the distribution of the Sharpe ratios are often overstated and that rankings can change dramatically in the presence of autocorrelation. This follows Lo

(2002) argument that investors should not naively compare Sharpe ratios across alternative investments without considering appropriate statistical adjustments for each return series.

The unrealistically low standard deviation for direct property is in part caused by the limited number of property market transactions. To overcome this, direct property data series are appraisal based, utilising historical transactional evidence with the implications that valuations may occur less often than the produced indices.

The property data issues described above can be addressed as follow:

i. By mitigating the autocorrelation problem by using property returns that are adjusted to minimise autocorrelation, the Adjusted Sharpe (AS) ratios can then be re-calculated.

ii. To integrate the non-normality into the Sharpe ratio, the Modified Sharpe (MS) ratios is calculated by using a modified value-at-risk (MVaR) dominator, rather than the standard deviation, (as the measure of risk) in order to explicitly account for any skewness and excess kurtosis in the return distribution.

iii. Finally, the research calculates the Adjusted Modified Sharpe (AMS) ratios designed to minimise the impact of non-normality in the adjusted returns series.

For stage one, to mitigate any positive autocorrelation in the return series, the research uses the following equation recommended by Fisher *et al* (1994):

$$\mathbf{R_t} = \frac{\mathbf{R_t^* - \alpha R_{t-1}^*}}{\mathbf{1 - \alpha}} \qquad (2)$$

where α = parameter of the first order autoregressive obtained from the same series (R) return of fund

where R_t and R_t^* are the true underlying (unobservable) return and the observed return at time t respectively. The variable α is set to equal the slope coefficient from the regression of R_t^* on R_{t-1}^* . The results are presented in Table 4**.**

Table 4: Raw and de-smoothed Australian property, bonds and equities data

	Asset class	Raw data	Desmoothed data
Prime Office	Sydney CBD	0.58	0.19
	Melbourne CBD	0.66	0.21
	Brisbane CBD	0.58	0.17
	Perth CBD	0.58	0.15
Retail	NSW	0.42	0.10
	Victoria	0.21	0.03
	Queensland	0.62	0.34
	WA	0.41	0.01
Industrial	Sydney	0.58	0.26
	Melbourne	0.44	0.09
	Brisbane	0.35	0.17
	Perth	0.46	0.17
All Ordinaries		-0.25	0.02
A-REIT 300		0.00	0.00
10 year Bonds		-0.18	0.02

Table 4 illustrated the high autocorrelation in the raw Australian property investment market data with six property investment markets having an autocorrelation above 0.50. This contrasted to the financial securities which showed no evidence of autocorrelation. The desmoothed property data reduced with an autocorrelation below 0.25, except Queensland Retail autocorrelation which is 0.34. The descriptive statistics and adjusted Sharpe ratios for the desmoothed data is detailed in Table 5.

Table 5: De-smoothed descriptive statistics and adjusted Sharpe ratios

	Asset Class	Mean	Rank	SD	Rank	SR	Rank
Prime Office	Sydney CBD	8.56	14	25.68	2	0.01	14
	Melbourne CBD	8.10	15	23.60	3	0.00	15
	Brisbane CBD	9.59	13	17.26	6	0.08	12
	Perth CBD	10.24	12	30.08	1	0.07	13
Retail	NSW	12.57	5	9.97	12	0.44	3
	Victoria	12.61	4	8.87	15	0.50	2
	Queensland	12.97	3	12.01	9	0.40	5
	WA	14.34	1	10.44	11	0.59	1
Industrial	Sydney	10.80	10	15.13	8	0.17	10
	Melbourne	12.50	6	11.89	10	0.36	6
	Brisbane	11.18	9	9.25	14	0.32	8
	Perth	12.04	8	21.42	4	0.18	9
All Ordinaries		13.94	2	16.47	7	0.35	7
A-REIT 300		10.60	11	18.28	5	0.13	11
10 year Bonds		12.16	7	9.72	13	0.41	4

In Table 5, the de-smoothing process has substantially removed the significant positive autocorrelation in the property returns, with little impact on expected returns. By comparing Table 5 with Table 2, the research shows that after de-smoothing, all the standard deviations of the property market segments showed a significant increase, in most instances doubling the volatility.

Also, Table 5 shows the Adjusted Sharpe (AS) ratios based on the desmoothed annual returns. The results show that the AS ratio of the property market segments (i.e., after considering autocorrelation) still compares favourably with the securitised investment markets, although as expected, the ranking for 10-year Bonds improved from 8th to 4th best. The normality distribution for the desmoothed data is shown in Table 6.

Table 6: Non-symmetrical statistics: Australian property, bonds and equities data

	Asset Class	Skew	Rank	Kurt	Rank	JB	Prob
Prime Office	Sydney CBD	0.59	10	1.23	6	1.61	0.45
	Melbourne CBD	-0.35	6	0.75	8	1.12	0.57
	Brisbane CBD	-0.30	5	0.26	10	0.38	0.83
	Perth CBD	-0.83	11	1.31	5	2.34	0.31
Retail	NSW	0.39	7	2.64	1	8.90	0.01
	Victoria	2.06	15	7.19	15	63.20	0.00
	Queensland	-0.58	9	0.72	9	0.98	0.61
	WA	-0.13	1	0.07	12	0.05	0.98
Industrial	Sydney	-1.38	13	2.33	2	15.53	0.00
	Melbourne	-0.20	3	0.18	11	0.20	0.91
	Brisbane	-0.29	4	0.90	7	1.62	0.44
	Perth	-1.23	12	2.24	3	8.74	0.01
All Ordinaries		-0.17	2	1.64	4	2.32	0.31
A-REIT 300		-1.96	14	6.70	14	1.29	0.53
10 year Bonds		-0.41	8	-0.39	13	0.79	0.67

In using desmoothed data, Table 6 shows that the unattractive feature of negative skewness and positive excess kurtosis is now not evident in the property markets, with only A-REITs showing these features. The JB statistics remained the same, with the assumption of normality being rejected for four property markets: NSW Retail, Victoria Retail, Sydney Industrial and Perth Industrial.

In order to account for the non-normality in the data, the research adopts a risk measure that explicitly accounts for any skewness and excess kurtosis in the return distribution. Such a measure is the modified value at risk (MVaR) statistic presented by Favre and Galéano (2002). This well-known formula for the standard value-at-risk (VaR) is shown below:

$$VaR = \mu + z(\alpha)\sigma \tag{3}$$

where μ and α are, respectively, the sample mean and standard deviation of returns the value of the alpha-quantile of the standard normal distribution z(α) is replaced by the value of the Cornish-Fisher (CF) expansion $\Omega(\alpha)$:

$$\Omega(\alpha) = z(\alpha) + \frac{1}{6}(z(\alpha)^2 - 1)S + \frac{1}{24}(z(\alpha)^3 - 3z(\alpha))K - \frac{1}{36}(2z(\alpha)^3 - 5z(\alpha))S^2 \tag{4}$$

where:

S = is the estimated skewness of the data
K = is the estimated excess kurtosis of the data
$\Omega(\alpha)$ = is the critical value in the VaR calculation in order to take account of skewness and excess kurtosis.

The CF expansion penalise assets which exhibit negative skewness and excess kurtosis by making the estimated quartile more negative and so increasing the VaR, but rewards assets with positive skewness and little or no kurtosis by making the estimated quartile less negative and so reducing the VaR. The standard value-at-risk (VaR) and the modified value-at-risk (MVaR) are detailed in Table 7.

Based on the desmoothed data, Table 7 shows the standard value-at-risk (VaR) and the modified value-at-risk (MVaR) at a confidence level of 5% (z(α) = -1.64). Across the property markets, the VAR and MVAR results were similar, which reflects relatively low skewness as a result of the desmoothing process. In contrast, A-REITs showed greater MVaR than their standard VaR equivalent due to the negative skewness in their desmoothed return series (see Table 6).

On knowing the value-at-risk (VaR) and the modified value-at-risk (MVaR), the study can calculate the Modified Sharpe (MS) ratios using the desmoothed data, where the standard deviation in the traditional Sharpe Ratio is replaced by the absolute value of either VaR or MVaR. This respectively produces the VaR Sharpe and Modified Sharpe Performances as shown in Table 8.

Table 7: VaR, MVaR and modified Sharpe ratios: desmoothed data

	Asset Class	VaR	Rank	MVaR	Rank
Prime Office	Sydney CBD	-33.68	14	-29.95	11
	Melbourne CBD	-30.73	13	-33.10	12
	Brisbane CBD	-18.81	10	-20.38	9
	Perth CBD	-39.24	15	-48.37	15
Retail	NSW	-3.83	4	-2.41	2
	Victoria	-1.98	1	-0.66	1
	Queensland	-6.79	6	-9.14	7
	WA	-2.83	2	-3.21	3
Industrial	Sydney	-14.09	9	-23.22	10
	Melbourne	-7.06	7	-7.75	6
	Brisbane	-4.03	5	-4.74	4
	Perth	-23.20	12	-34.19	13
All Ordinaries		-13.15	8	-13.49	8
A-REIT 300		-19.47	11	-36.77	14
10 year Bonds		-3.83	3	-5.26	5

Table 8: Desmoothed Sharpe, VaR Sharpe and modified Sharpe performances

	Asset Class	Sharpe (1)	Rank	VaRS (2)	Rank	MSharpe (3)	Rank
Prime Office	Sydney CBD	0.01	14	0.01	15	0.01	15
	Melbourne CBD	-0.00	15	0.26	13	0.24	13
	Brisbane CBD	0.08	12	0.51	12	0.47	9
	Perth CBD	0.07	13	0.26	14	0.21	14
Retail	NSW	0.44	3	3.28	3	5.23	2
	Victoria	0.50	2	6.37	1	19.10	1
	Queensland	0.40	5	1.91	6	1.42	7
	WA	0.59	1	5.07	2	4.47	3
Industrial	Sydney	0.17	10	0.77	9	0.47	10
	Melbourne	0.36	6	1.77	7	1.61	6
	Brisbane	0.32	8	2.78	5	2.36	4
	Perth	0.18	9	0.52	11	0.35	11
All Ordinaries		0.35	7	1.06	8	1.03	8
A-REIT 300		0.13	11	0.54	10	0.29	12
10 year Bonds		0.41	4	3.18	4	2.31	5

Table 8 accounts for the combined effects of non-normality and autocorrelation by calculating the Modified Value-at-Risk of the de-smoothed return series. By comparing

the Modified Value-at-Risk Sharpe Performance (Table 8, column 3) with the traditional Sharpe performance (Table 8, column 1), the research shows that after accounting for autocorrelation and non-normality, the ranking of the valuation-based property data, in most instances, is the same.

This can be substantiated by the Spearman rank correlation test. When applied to the Modified Value-at-Risk Sharpe Performance data and the traditional Sharpe performance data, the Spearman rank correlation is relatively high at $r = 0.82$ and so confirms the similarity in ranking between the two data sets.

These results therefore indicate that overall property does indeed show good Sharpe performance against shares, even after we account for non-normality and any autocorrelation in the data. This provided an important signpost for Australian asset allocation in a diversified portfolio.

CONCLUSION

Based on the IPD/PCA Annual total return 1985 to 2008 data, the research shows that the Australian direct property data has substantial departures from normality and display significant positive autocorrelation, whereas the equity market indices show no real evidence of autocorrelation. Both non-normality and autocorrelation in returns are ignored in the traditional Sharpe ratio, which Weisman and Abernathy (2000) noted can lead investors to invest in assets which in reality maximises risk (due to taking on negative skewness and excess kurtosis) and creating a portfolio that is less liquidity (due to investing in assets with valuation-based returns which have the appearance of stable, superior returns). This implies that a true evaluation of the Sharpe performance of direct property against financial assets requires consideration of autocorrelation and non-normality in the data series.

This research calculates a number of Sharpe ratios to examine the joint effects that autocorrelation and non-normality have on the risk-adjusted performance of property in comparison with shares and bonds. The results indicate that direct property in Australia still shows good risk-adjusted performance, in comparison with shares and bonds, even after the effects of non-normality and autocorrelation are taken into account. Therefore the Sharpe performance measure is a sound risk-adjusted return benchmark and property does offer diversification benefits in an investment portfolio that contains shares and bonds.

REFERENCES

Bernstein P, 2007, *Capital Ideas Evolving,* John Wiley, New Jersey.

Brown G and Matysiak G, 2000, *Real Estate Investment: A Capital Market Approach*, Prentice Hall, London.

Favre L and Galéano J-A, 2002, Mean-Modified Value-at-Risk Optimization with Hedge Funds, *Journal of Alternative Investments*, Vol. 5, p21-25.

Fisher J, Geltner D and Webb R, 1994, Value Indices of Commercial Real Estate: a Comparison of Index Construction Methods. *Journal of Real Estate Finance and Economics,* Vol. 9, p137-164.

Higgins D, 2008, *Commingled Four Quadrant Property Funds: Creating an Investment Framework*, Pacific Rim Real Estate Society Conference, Kuala Lumpur, January.

Higgins D , Ditrocchio N and Hughes N, 2008, Mapping the Australian Property Investment Universe, School of Property, Construction and Property Management, RMIT University, Working paper.

Lee S, 2008, *Sharpe Performance by Property,* Pacific Rim Real Estate Society Conference, Kuala Lumpur, January.

Lo A, 2002, The Statistics of Sharpe Ratios, *Financial Analysts Journal*, Vol. 58, p36-52.

IPD/PCA, 2009, *IPD Australian Digest Q4 2008*, Investment Property Databank, Melbourne.

Scott R and Horvath P, 1980, On the Direction of Preference for Moments of Higher Order than the Variance, *Journal of Finance*, Vol. 35, p915-919.

Sharpe W, 1966, Mutual Fund Performance, *Journal of Business*, Vol. 39, p119-138.

Sharpe W, 1994, The Sharpe Ratio, *Journal of Portfolio Management*, Vol. 21, p49-58.

Travers F, 2004, *Investment Managers Analysis: A Comprehensive Guide to Portfolio Selection, Monitoring and Optimisation*, Wiley Finance, New Jersey.

Weisman A and Abernathy J, 2000, The Dangers of Historic Hedge Fund Data, in Rahl, L., ed. *Risk Budgeting*, Risk Books, London.

Young M, Lee S and Devaney S, 2006, Non-Normal Real Estate Return Distributions by Property-Type in the U.K., *Journal of Property Research,* Vol.23, p109-133.

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