The Appropriate Efficiency Frontier for the LPT Sector – An Explorative Study*

by

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Abstract

Listed Property Trusts (LPTs) are an important asset class for creating wealth. The dynamics of the current Australian environment presents investors with greater investment challenges in deciding which securities should be included in an investor's portfolio. The validity of the standard Markowitz framework is examined in the context of the nature of the return distributions in the Australian listed property trust sector. Empirical evidence of non-normality in the return distributions raises questions regarding choices made by utility maximizing investors using the conventional Markowitz framework. A sample of Australian LPTs is used to explore the appropriateness of a semi-variance methodology in determining efficiency frontiers with that of the conventional approach. Results indicate that for the chosen sample the Markowitz approach is sub-optimal for investors that are very averse to downside risk.

Keywords: downside risk, semi-variance, efficiency frontier, LPT sector, portfolio construction, asset weights

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1. Introduction

Property has long been considered an important asset class for inclusion in a portfolio of growth assets. Property provides stability of income as well as the opportunity to generate capital appreciation over time.

Studies indicate that adding property to a portfolio of mixed assets offers substantial benefits while at the same time offering protection against unanticipated inflation. An early 1980s study by Ibbotson and Siegel (cited in Clauretie & J. R. Webb, 1993 pp. 581-584) indicated that the average annual return and standard deviation, (M, SD), on property from 1947 to 1982 was (8.27%, 3.71%). This compared with (3.98%, 4.92%) on U.S. government securities and (3.56%, 6.47%) on corporate debt. The annual return and standard deviation for corporate stocks over this period was (11%, 17.52%).

Property trusts listed on the Australian Stock Exchange during the period 1984-2003 generated an annual average return of 14% with a 20-year standard deviation of 2.49% (refer Table 2). Over this period the risk-return trade-off for property indicated that it was a superior investment to any other asset. In the case of direct property, the volatility of returns is subject to the smoothing effect of valuations and infrequent trading, which makes it difficult to accurately measure risk. Since direct ownership and ownership through a listed trust represents the same underlying asset, real property, the long term returns for both forms of investment should be similar.[1] Due to the illiquidity of direct property, this form of ownership should enjoy a premium of return compared with ownership through a listed trust. This premium would be eroded somewhat if the direct owner was very large and not subject to the vagaries of the market. Large pension funds are well placed to withstand cyclical movements in the property market and are unlikely to require a substantial premium on return for this form of ownership.

The diversification benefits of property over this period are also attractive, based on the low or negative correlations with other asset classes, as indicated in tables 1 and 2. Ibbotson and Siegel concluded that property offered superior returns if held as an asset in isolation and excellent diversification benefits if held in a mixed asset portfolio. This conclusion was supported by a later study which found that when optimal portfolios were constructed property would dominate: optimal portfolios would consist of nearly 75% property, approximately 15% small corporate stock and only 5% common stock, with government bonds representing a negligible part.[2]

Ibbotson and Siegel suggested that the superior returns offered by property are a reward for some of the unique risk characteristics of that asset. The major elements of risk are:

- *residual risk* — the difficulty for other than large investors to diversify property holdings

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[1] This view is supported by R. Clarke and A. Noble., 1999.

[2] J.R. Webb & J. Rubens, (1998) [Cited in Clauretie & Webb, pp. 582-583]

- *marketability costs* property is relatively illiquid, particularly at the upper end of the market where it can take months or even years to sell a large property.

- *information costs* the cost of obtaining all sufficient information to make an informed and rational investment in property. Information such as proposed zoning changes, changes in the infrastructure, and changes in the local economy is costly to obtain.

Table 1: Selected Cross-Correlations of Asset Returns, 1947-1982

	Real Estate	S&P Common Stock	Small Company Stock	Long-term Corp. Bonds	Long-term Govn. Bonds	U.S. Treas. Bills
Real Estate	1.00					
S&P Common Stock	-0.64	1.00				
Small company stock	0.04	0.79	1.00			
Long-term corporate bonds	-0.06	0.14	0.05	1.00		
Long-term government bonds	-0.08	0.01	-0.06	0.95	1.00	
U.S. treasury bills	0.44	-0.25	0.00	0.15	0.21	1.00

Source: Ibbotson and Siegel, "Real Estate Returns: A Comparison With Other Investments," ***AREUEA Journal***, Vol.12, No. 3, (1984), Table 3, pg. 231. [Cited in Clauretie & Webb, page 583]

Table 2. 20-Year Investment Returns in Australian Asset Classes 1984-2003

	CPI[1]	Cash[2]	ASX[3]	Prop[4]	MSCI[5]	Bonds[6]
Average return	4.20	9.76	13.57	14.00	14.35	11.58
20-yr St Dev	0.62	1.12	3.53	2.49	5.21	1.48

Correlation between Asset Classes

	CPI	Cash	ASX	Prop	MSCI
CPI	1.00				
Cash	0.82	1.00			
ASX	0.33	0.40	1.00		
Prop	0.14	0.24	0.65	1.00	
MSCI	0.18	0.32	0.70	0.28	1.00
Bonds	0.13	0.49	0.14	0.31	0.18

1. **CPI** - Headline inflation (2003 represents year to March 2003)
2. **Cash** - 90-Day Bank Bills
3. **Aust. Shares:** S&P/ASX All Ordinaries Accumulation Index
4. **Property:** S&P Listed Property Accumulation Index
5. **International shares:** MSCI (Morgan Stanley Capital International) World Accumulation Index
6. **Bonds:** Commonwealth Bank Bond All Maturities Accumulation Index

Source: ***The Australian Master Financial Planning*** Guide 2003/4 (**CCH**)

From Table 2, it will be observed that during the twenty year period to 2003 Australian listed property trusts (LPTs) outperformed Australian equities. A major factor contributing to this outcome was the exceptionally poor performance of equities during the last three years of the analysis. Nevertheless, property has consistently been a strong performer with superior returns and lower risk, when compared with other asset classes, making it an important asset class for inclusion in portfolios focused on wealth creation and income generation.

Most studies indicate that property should occupy a larger role in the portfolios of large institutional investors and cite lack of liquidity as one of the primary reasons why they have not increased their investment in this asset class.

The recent wave of mergers in the listed property trust market in Australia is ushering in a new era for this investment class. The internationalisation of many of the larger trusts adds an additional risk component for domestic investors, arising from movements in exchange rates. The drift towards internationalisation is likely to continue due to the growth in funds in this asset class and lack of suitable properties available in the Australian market. [3]

The strong performance of LPTs over time will ensure that investors will continue to focus on this asset class as an important component of a diversified portfolio. The ability to choose from among the available LPTs raises the issue of asset allocation within this asset class.

This paper explores the appropriateness of the standard mean-variance framework for arriving at optimal asset allocations after first investigating the nature of the returns distributions. A sample of Australian LPTs is employed as the basis for this analysis.

The remaining sections of this paper are organised as follows. Section 2 provides the theoretical underpinning for the methods employed in the ensuing analysis. Section 3 discusses the data and presents various diagnostic tests to examine the nature of the return distributions. Section 4 illustrates with an example, how the standard Markowitz approach to determine portfolio weights, may perform sub-optimally as compared with the semi-variance approach.

2. The Mean-Variance and Semi-Variance Framework

Strictly speaking, the application of the mean-variance framework for investment decision-making is justified when investors are 1) insatiable expected utility maximizers 2) imbued with risk aversion and 3) either possess quadratic utility functions and/or are faced with the task of investing in assets whose returns are normally distributed (Elton and Gruber 2002). But even if some of the assumptions are violated, the framework may still remain approximately valid (Markowitz cited in Elton and Gruber 2002)

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[3] The annual National property Funds Forum 2004 hosted by Property Investment Research (PIR) was titled “Get Big or Get Out?” (27-29 October 2004 at Radisson Resort, Gold Coast).

However in some situations where return distributions are markedly non-normal and cannot be uniquely described by their mean and variance, reference may have to be made to other parameters of the return distribution that may affect investor preferences. Markowitz (cited in Grootveld and Hallerback, 1999) recognised this early on and was even responsible for bringing the concept of downside risk (as measured by semi-variance) to the attention of finance scholars.

The discovery of appropriate asset weights for minimising risk, subject to a given level of expected return, is not significantly affected by the non-normality of returns provided the distribution is reasonably symmetrical. However, a problem does arise if the return distribution is skewed. For the case of an asymmetric return distribution, the minimisation of variance is not equivalent to the minimisation of downside risk and the indicated portfolio weights associated with any given selected point on the Markowitz efficiency frontier may be inappropriate.

The conventional Markowitz model to determine the optimal weights for the inclusion of assets in mean-variance efficient portfolios may be stated as:

$$\text{Min} \qquad V_P = \boldsymbol{\sigma}_P^2 = \sum_i \sum_j w_i w_j \boldsymbol{\sigma}_{ij} \qquad (1)$$

$$\text{Subject to} \qquad \sum_i w_i E(r_i) = M_P$$

$$0 \le w_i \le 1$$

$$\sum_i w_i = 1 \qquad \forall i$$

where V_P is the portfolio variance, w_i is weight assigned to the i^{th} asset in the portfolio, σ_{ij} is the covariance of asset i with asset j, and M_P represents the mean or expected portfolio return.

The entire model is essentially determining the set of asset weights that minimise portfolio variance subject to 3 conditions: that a given mean portfolio return is attained, that no weight is larger than 1 or less than zero and finally that all asset weights sum to 1 (100% of the portfolio) .

When the efficient frontier for the mean-variance model is charted, it is the square root of the portfolio variance or the portfolio standard deviation (SD_P) against which mean portfolio return is graphed.

This model which assumes normal asset return distributions - can also be used reasonably safely when the distributions are not normal but are still approximately symmetrical (say a near symmetrical triangular distribution).

An alternative model considered in this paper belongs to a family of models known as the mean-lower partial moment model (MLPM-model). A very informative discussion of this family of models may be found in Grootveld and Hallerbach (1999).

The specific model utilised in this paper may be written as:

$$\text{Min} \qquad SV^- = \frac{\sum \left[Max(0, M_P - r_P) \right]^2}{N} \tag{2}$$

$$\text{Subject to} \qquad \sum_i w_i E(r_i) = M_P$$

$$0 \le w_i \le 1$$

$$\sum_i w_i = 1 \qquad \forall i$$

where SV^- is the downside portfolio semi-variance and the remaining symbols are as defined previously for equation (1).

When the efficient frontier for the semi-variance model is charted, it is the square root of the downside semi-variance or the portfolio semi-standard deviation (SSD_P) against which mean portfolio return is plotted.

A measure that is related to SV^- is the up-side semi-variance, represented symbolically as SV^+.

$$SV^+ = \frac{\sum \left[Max(0, r_P - M_P) \right]^2}{N} \tag{3}$$

An important relationship exists among SV^- and SV^+ namely that their sum always equals the variance, that is,

$$V = SV^- + SV^+ \tag{4}$$

Henceforth, the ratio of SV^- to SV^+ will be referred to as the semi-variance ratio (SVR). When SVR equals unity, the distribution is expected to be symmetrical. If SVR exceeds unity, negative skewness is likely to be present. Conversely positive skewness is most likely to be accompanied by an SVR less than unity.

3. The Data and Preliminary Analysis

Monthly data on the total return index for the months February 2000 to June 2004 were accessed from Aspect Financial Pty Ltd – a total of 53 observations for each of 36 LPTs appearing in its database. These LPTs are listed in Table A1 of the Appendix along with their market capitalisation as of Sept 28th 2004 when the data were accessed. The LPTs have been sorted by property investment category and market capitalisation respectively.

Care must be taken when defining the universe of LPTs in Table A1. For example, Westfield America (WFA) and Westfield Trust (WTA) were absorbed into Westfield Group Stapled (WDC) during the sample period. There are several approaches to defining the LPT universe to cater for such a consolidation. The first approach would include both WFA and WFT in the universe but exclude WDC. A second option would include WDC but exclude WFA and WFT. A third more theoretically satisfactory approach would be to disentangle the effects of

WFA and WFT on WDC to arrive at a residual WDC that could be included in the LPT universe alongside WFA and WFT. With no clear-cut way of implementing the last option, only the first two approaches are considered in this paper. Through time, further consolidations of LPTs will complicate the task of precisely defining the elements comprising the LPT universe.

52 continuous monthly returns for each of the 36 LPTs listed in Table A1 were calculated from the initial data set. The returns for each LPT were subjected to the Jarque-Bera (1987) normality test. In order to test for significant skew (SK) and non-normal kurtosis (K) the Jarque-Bera normality test statistic (JB-Test) was subsequently broken down into its two components: the skew test statistic (SK–Test) and the kurtosis test statistic (K-Test). The complete results are listed in Table A2 of the Appendix.

Of the 36 property trusts, 19 (53%) were found to exhibit non-normality using the JB test at the 5% significance-level. 17 (47%) exhibited significant skew and 16 (44%) exhibited non-mesokurtosis[4] (i.e. non-normal peakedness and/or thickness of tails in the return distribution). All 16 cases of statistically significant non-mesokurtosis, indicated the presence of leptokurtosis and in only 4 of these cases was such leptokurtosis unaccompanied by significant skew. On the other hand, of the 17 cases of statistically significant skew, 6 (11) indicated positive (negative) skew.

Table A2, indicates that the hypothesis of normality remains un-rejected across all LPTs in the Office and Industrial categories. However, normality is rejected in 88% of the LPTs that are categorised as Hotel/Leisure and Diversified. Finally, normality is rejected for 33% (22%) of LPTs categorised as Commercial (Retail). With a number of exceptions, non-normality is more typical of the smaller cap trusts. Indeed, 79% of the incidence of non-normality is found in LPTs whose market capitalisation is less than $1.2 billion. Together these LPTs have a total market capitalisation that is only 11.5% of that associated with the largest LPT namely WDC. Four larger LPTs (IPG in the Commercial Sector and MGR, SGP and GPT in the Diversified sector) exhibit non-normal returns. Their combined market capitalisation is $19.481 billion which represents around 76% of WDC's market capitalisation.

Significant leptokurtosis and skew are primarily the attributes of LPTs in the Diversified and Hotel and Leisure groupings with very little incidence of significant leptokurtosis and skew elsewhere. Whilst significant negative skew is more common than positive skew, the latter – in the few cases that it does arise – is present in some other LPTs with very large market capitalisations (GPT, MCW and WDC).

The presence of skew in many of the listed trusts, means that variance is an unreliable measure of *downside* risk. Another way of measuring the asymmetry of return distributions is to compute the semi-variance ratio, SVR (SV^{-}/SV^{+}). In a

[4] If the distribution of returns follows a normal distribution then it is described as mesokurtic meaning that its peakedness and fatness of tails is typical of a normal distribution. If it has fatter than normal tails and/or more peakedness it is referred to as leptokurtic. It is referred to as platykurtic if the distribution has slimmer tails and a less pronounced peak than a normal distribution.

normal distribution one would expect this ratio to equal unity. Hence, the more this ratio exceeds unity, the less confidence one has about implementing the conventional Markowitz framework to obtain the risk minimising portfolio weights associated with a nominated expected return.

Such a semi-variance ratio has been computed for each LPT with the results appearing in the last column of Table A3. This ratio exceeds unity[5] in all cases where the skew measure SK is negative with one anomalous exception.[6] The mean value of this ratio across LPTs with a negative skew is 1.44 and for the entire set of LPTs listed in Table A3, it is 1.25.

Up to now the return distributions of single LPTs have been considered. The next matter to inquire into is the behaviour of the return distributions of portfolios comprising all LPTs in the LPT universe.

Earlier, a remark was made about some of the difficulties in defining the universe of LPTs against a backdrop of LPT consolidations. In what follows, four different LPT portfolios are considered. The first two are *equally weighted* portfolios. The first (second) excludes (includes) WFA and WFT but includes (excludes) WDC. The LPTs included in the third and fourth portfolios are analogous to those included in the first and second respectively except that they are *weighted* portfolios. In such weighted portfolios, the weight assigned to a specific LPT is taken as the ratio of its market capitalisation to the market capitalisation of the entire LPT universe.

Relevant statistics for these four portfolios are indicated in Table A4. The Jarque-Bera tests indicate the absence of significant skew, non-normal kurtosis and non-normality. However, the sign of the skew coefficient SK is negative across all portfolios and each semi-variance ratio (SVR) exceeds unity by a seemingly healthy margin.

4. Exploration of the adequacy of the Markowitz framework

Judgement was used in selecting the trusts to be included in the explorative sample. In effect, the selected trusts constitute a judgement sample. Care was taken to ensure representation across the more significant trust categories.

The possibility that the conventional Markowitz framework may not operate satisfactorily in the presence of skew is illustrated with a small example involving only four LPTs: SGP, MOF, MCW DOT (see Table A2) which will be treated as an illustrative universe for which efficiency frontiers will be constructed. Each of these LPTs represent one of the LPTs in the Diversified, Commercial, Retail and Office categories. The Hotel/Leisure category has been excluded as it is quite

5 The assumptions underlying the valid application of the F-test (namely normality and the independence of distributions associated with the means squared deviations in the numerator and denominator of the F-statistic) imply that it cannot be used to test whether this ratio significantly exceeds unity (or equivalently that downside risk exceeds upside risk).

6 This anomaly is present in the return distribution of the Gandel trust. We have not been able to identify a plausible reason for this anomaly at this stage.

small compared to the other categories in the LPT universe. In addition, most of trusts in this category, 7 out of 8, exhibit significant negative skewness which could have potentially biased the results.

It is seen from Table A2 that SGP (from the diversified sector) and MOF (from the Commercial Category) have significant negative skew, MCW (from the Retail Category) has significant positive skew and that DOT (from Office Category) does not possess significant skew.

An optimiser (Excel's Solver program) was used to locate points on a conventional Markowitz efficiency frontier for these 4 LPTs. The asset weights associated with the efficient mean-standard deviation pairs (SD, M) appear in table 3 below. The first row of table 3 provides information relating to the maximum return portfolio. The last row of the table contains information relating to the minimum variance portfolio.

When these (SD, M) pairs are plotted as an efficiency frontier it appears as the right-most of the two frontiers seen in Figure 1. The remaining curve is the transformation of the initial Markowitz frontier into one that indicates the level of downside risk associated with each point on the original efficiency frontier.

The statistic used to measure downside risk at different points on the modified frontier is the downside semi-standard deviation SSD. It is the square root of the downside semi-variance SV^-. The semi-standard deviation, SSD, is the most appropriate measure of downside risk to plot along the horizontal axis. This is because it is measured in the same units as the standard deviation.

Table 3. Mean-Variance Efficient Portfolios and associated Asset Weights

Asset Weights				Efficient [SD, M] pairs	
DOT	MCW	MOF	SGP	M	SD
0.000000	0.000000	0.000000	1.000000	0.014999	0.033599
0.000000	0.093931	0.000000	0.906069	0.014750	0.031642
0.000000	0.188196	0.000000	0.811804	0.014500	0.029913
0.000000	0.282460	0.000000	0.717540	0.014250	0.028464
0.000000	0.376725	0.000000	0.623275	0.014000	0.027339
0.000000	0.463718	0.003064	0.533218	0.013750	0.026577
0.000000	0.448781	0.049076	0.502143	0.013500	0.026005
0.000000	0.433845	0.095088	0.471067	0.013250	0.025469
0.000000	0.418908	0.141100	0.439992	0.013000	0.024972
0.000000	0.403971	0.187112	0.408917	0.012750	0.024517
0.000000	0.389035	0.233124	0.377841	0.012500	0.024106
0.000000	0.374098	0.279136	0.346766	0.012250	0.023741
0.000000	0.359162	0.325148	0.315691	0.012000	0.023425
0.010426	0.349765	0.353340	0.286469	0.011750	0.023155
0.028850	0.344617	0.367863	0.258670	0.011500	0.022915
0.047273	0.339469	0.382387	0.230871	0.011250	0.022703
0.065697	0.334321	0.396911	0.203072	0.011000	0.022520
0.084120	0.329173	0.411434	0.175272	0.010750	0.022366
0.102544	0.324025	0.425958	0.147473	0.010500	0.022243
0.120967	0.318877	0.440481	0.119674	0.010250	0.022151
0.139391	0.313730	0.455005	0.091875	0.010000	0.022090
0.165759	0.306362	0.475791	0.052088	0.009642	0.022058

Before the transformed Markowitz efficiency frontier is compared with one that is derived by minimising downside portfolio semi-variance, it is instructive to discuss the magnitude of the semi-variance SV^-/SV^+ ratio as one moves from point to point along the Markowitz efficiency frontier. The ratio ranges from a minimum of 1.43 to a maximum of 1.76, with an average value of 1.63. The ratio is least for the maximum return portfolio and then progressively gets larger before dropping back somewhat. This suggests there may be some opportunities for attaining a lower level of downside risk over the middle and lower ranges of expected returns by minimising downside semi-variance rather than variance.

Figure 1: The Conventional and Transformed Markowitz Efficiency Frontiers

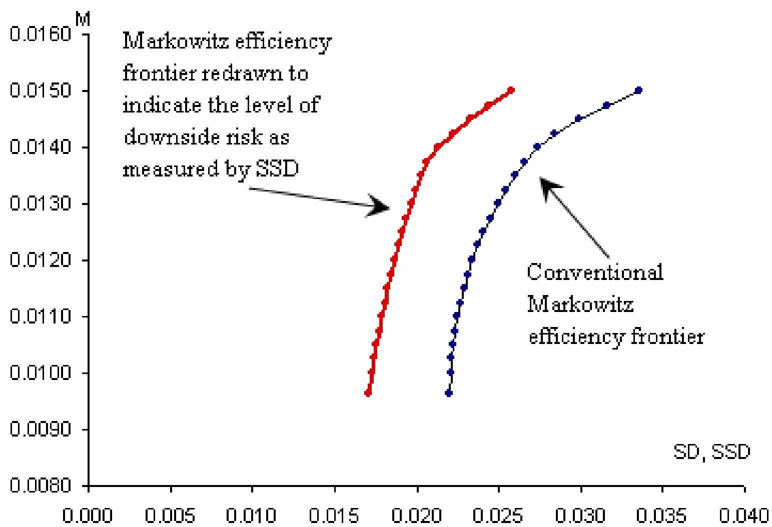


Table 4 exhibits the asset weights that minimize downside portfolio semi-variance SV for nominated levels of mean portfolio return M. The entries in the first row of the table are those pertaining to the maximum return portfolio and those appearing in the last row are associated with the minimum downside risk portfolio as measured by its downside semi-standard deviation SSD.

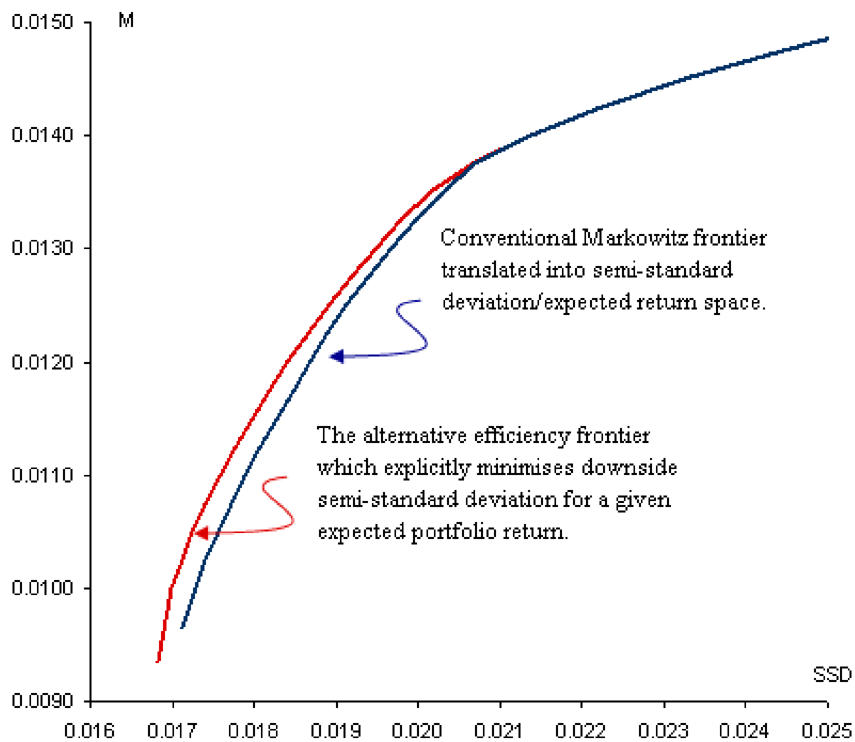
When the resultant (SSD, M) pairs are charted, they trace out a curve that may then be compared with the transformed Markowitz efficiency frontier described earlier. Such a chart is reproduced in Figure 2. It may be observed that for lower levels of downside risk, the transformed Markowitz efficiency frontier lies to the left of a new efficiency frontier arrived at by minimizing downside semi-variance.

The implication is clear. If the conventional Markowitz framework is employed to decide on the optimal investment allocation, then the opportunity of obtaining a higher return for a given level of acceptable downside risk may be foregone. Conversely, the very risk averse investor that refuses to abandon the prescriptions of the conventional Markowitz framework unwittingly sacrifices the attainment of a lower level of downside risk for a given targeted expected return.

Table 4. Mean/Downside Semi-Variance Efficient Portfolios and Associated Asset Weights

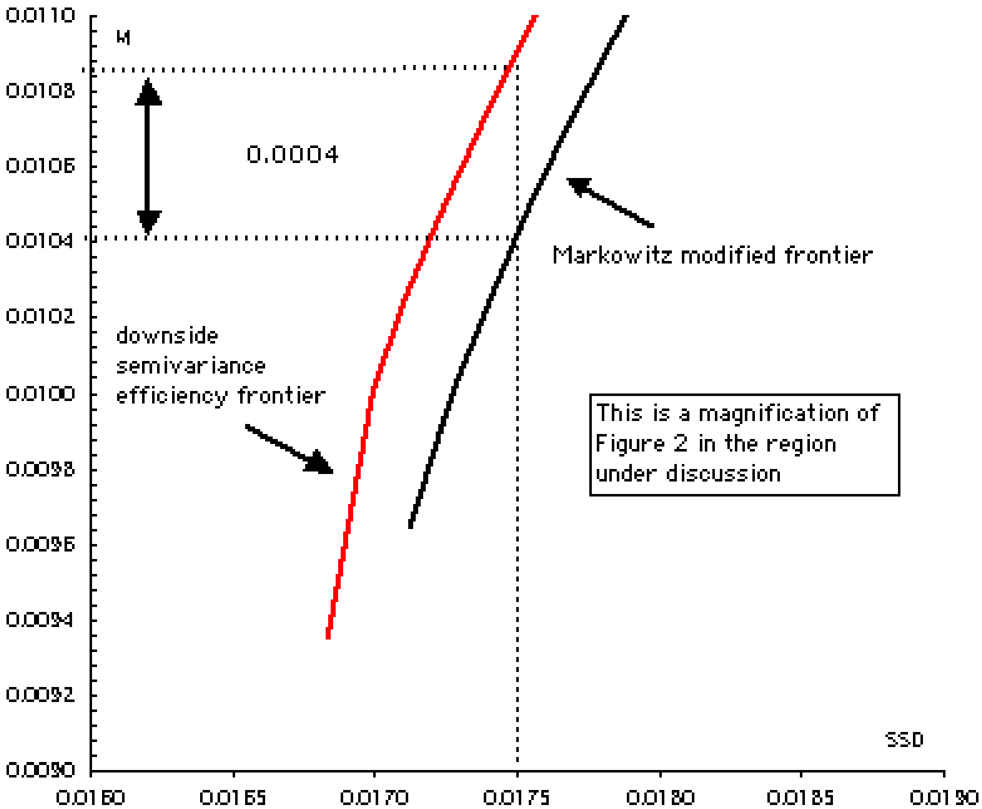
Asset Weights				Efficient [SSD, M] pairs		
DOT	MCW	MOF	SGP	M	SSD	SV
0.000000	0.000000	0.000000	1.000000	0.014999	0.0257642	0.000664
0.000000	0.093931	0.000000	0.906069	0.014750	0.0244453	0.000598
0.000000	0.188196	0.000000	0.811804	0.014500	0.0232643	0.000541
0.000000	0.282460	0.000000	0.717540	0.014250	0.0222422	0.000495
0.000000	0.376725	0.000000	0.623275	0.014000	0.0213718	0.000457
0.000000	0.470990	0.000000	0.529010	0.013750	0.0206673	0.000427
0.000000	0.565255	0.000000	0.434745	0.013500	0.0201449	0.000406
0.000000	0.601184	0.024580	0.374236	0.013250	0.0197914	0.000392
0.000000	0.586750	0.070380	0.342870	0.013000	0.0194816	0.000384
0.010159	0.576307	0.099410	0.314124	0.012750	0.0191970	0.000369
0.030423	0.570283	0.111569	0.287725	0.012500	0.0189253	0.000358
0.050492	0.564009	0.124122	0.261376	0.012250	0.0186657	0.000348
0.070562	0.557736	0.136675	0.235027	0.012000	0.0184187	0.000339
0.090874	0.551147	0.149001	0.208978	0.011750	0.0181850	0.000331
0.111473	0.544184	0.161058	0.183285	0.011500	0.0179658	0.000323
0.130822	0.536751	0.175170	0.157257	0.011250	0.0177618	0.000315
0.147804	0.530411	0.192336	0.129448	0.011000	0.0175744	0.000309
0.164786	0.524073	0.209502	0.101638	0.010750	0.0174037	0.000303
0.182017	0.518169	0.226116	0.073697	0.010500	0.0172501	0.000298
0.199421	0.512569	0.242344	0.045665	0.010250	0.0171141	0.000293
0.217041	0.506313	0.258528	0.018118	0.010000	0.0169961	0.000289
0.277847	0.410202	0.311952	0.000000	0.009350	0.0168367	0.000283

Figure 2: The Two Alternative Efficiency Frontiers Compared



There is another more intuitive way of couching the argument. In Figure 3 suppose a fairly risk averse investor were content with a level of downside risk of approximately .0175. Then, by adopting the downside semi-variance efficiency approach, the investor would gain an additional monthly continuous return of .00048 or in annual terms an extra .576 of 1%. Clearly, this is not inconsequential.

Figure 3: The payoff for being a downside risk rather than a variance minimiser



It is important to understand that the additional benefits arising from choosing portfolio weights indicated by the non-conventional framework are *not* available to all investors – only to those who are the most risk averse. Investors, who wish to achieve returns at or near the maximum attainable, will reap no gains by using the alternative framework.

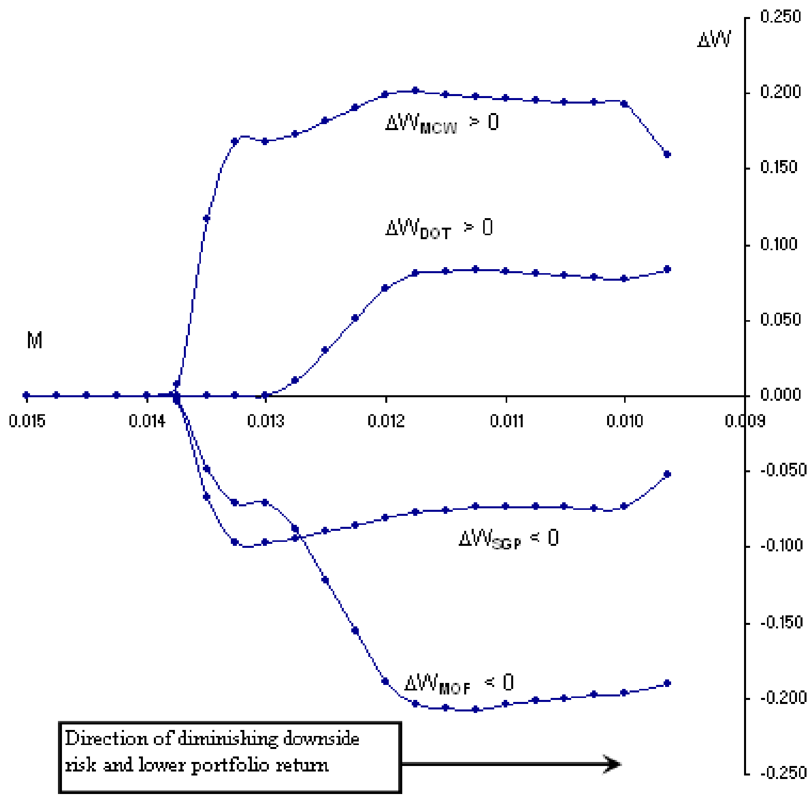
It is possible to gauge the effect on portfolio weights of minimizing downside semi-variance as opposed to variance by computing the root mean squared dispersion index RMSDI (Grootveld and Hallerback, 1999). Such an index is defined below:

$$RMSDI = \sqrt{\frac{1}{88}\sum_{i=1}^{22}\sum_{j=1}^{4}(w_{ij}^{SV} - w_{ij}^{MV})^2} \qquad (3)$$

where w_{ij}^{SV} and w_{ij}^{MV} represent respectively, the asset weight for the jth asset in the ith semi-variance efficient and mean variance efficient portfolios. The value of RMDSI is a surprising 0.11. By examining the sign of the differences in the weights in each portfolio it is also easy to see which approach favours which assets.

Figure 4 below is used to track the sign and magnitude of the *differences* ΔW_j (= w_{ij}^{SV} - w_{ij}^{MV}) in asset portfolio weights prescribed by the alternative efficiency frameworks, at various nominated levels of portfolio return M.

Figure 4: Differences in portfolio weights prescribed by the two alternative efficiency frameworks



In the chart as one moves to the right towards lower portfolio returns and downside risk, the weight differences for DOT and MCW become progressively more positive until they plateau. That they remain positive throughout simply indicates that the weights assigned by the conventional framework are less than those prescribed by the alternative approach. This makes much intuitive sense because DOT has no significant skew and MCW has significant positive skew. In other words, these are precisely the assets that the alternative semi-variance approach seeks to attract in its attempt to successively reduce downside risk as the trade-off for reducing portfolio return.

Conversely, in the case of MOF and SGP - both of which are characterised by negative skew - it comes as no surprise that the weight differences remain negative. All that is happening here is that the semi-variance approach is assigning less weight to assets with downside risk than the traditional mean-variance framework.

5. Summary, Conclusions and Implications

This partial study has found evidence of non-normality in several segments of the listed property sector. While there is some evidence of significant leptokurtosis, this in itself does not present a problem for the meaningful implementation of the mean variance approach to portfolio analysis. The problem however, is that in most cases the leptokurtosis is accompanied by significant skew and even when the former is absent skew also appears on its own. The presence of skew in both its negative as well as positive incarnations may handicap the usefulness of the standard mean-variance approach. For the case of positive skew, the mean-variance approach avoids the exploitation of upside risk. On the other hand, it does not sufficiently screen out from consideration assets that are characterised by downside risk.

Whilst evidence of significant positive skew is rare, in half the cases it occurs in the large LPTs, in particular the largest. On the other hand, significant negative skew seems to be located, with some exceptions among the smaller cap LPTs and is concentrated in particular market segments most notably the Diversified and Hotel /Leisure sectors and to a lesser degree the Commercial and Retail Sectors. Portfolios that mimic the listed property sector on either an equally weighted or market weighted basis do not appear to possess significant non-normality, skew or non-non normal kurtosis. However, their semi-variance ratios are much greater than unity.

A small judgement sample of listed property trusts was selected from various sectors of the LPT universe. The sample was chosen in such a way that the sign and significance of skew varied across the sampled entities. It was demonstrated that when a conventional mean variance approach to deriving an efficiency frontier was mapped into a mean semi standard deviation space, the resultant curve was suboptimal with respect to an alternative semi-variance efficiency frontier. However, the latter frontier was not found to be globally superior to the conventional one. Both converge at higher return portfolios. These are portfolios that would be chosen by the least risk averse in the investment community, Instead it is the most risk averse that have the most to gain if the insights emanating out of the judgment sample reflect a wider truth of what may occur in certain enclaves of the LPT sector. Future work in this area can establish this with greater certainty.

Appendix

Table A1: Listed Property Trusts – Sorted by Category and Market Capitalisation

Company	Symbol	Category	Mkt Cap ($m)
BIRON CAPITAL	BIC	Commercial	$14.0
FLEXI PROPERTY	FPF	Commercial	$69.5
MACQUARIE OFFICE TRUST	MOF	Commercial	$1,157.7
RONIN PROPERTY GROUP	RPH	Commercial	$1,173.0
COMMONWEALTH PR.OFFE.FD.	CPA	Commercial	$1,738.5
INVESTA PROPERTY GROUP	IPG	Commercial	$2,798.0
TARAGON PROPERTY FUND	TPG	Diversified	$3.0
MFS Leveraged Investment Group	MFS	Diversified	$36.0
ASPEN GROUP STAPLED	APZ	Diversified	$82.0
JF MERIDIAN TRUST	JFM	Diversified	$486.6
DEUTSCHE DIVR.TST.	DDF	Diversified	$1,255.7
MIRVAC GROUP	MGR	Diversified	$3,128.8
STOCKLAND	SGP	Diversified	$6,536.3
GENERAL PR.TST.	GPT	Diversified	$7,018.2
MFS LIVING AND LEISURE.	MPY	Hotel & Leisure	$4.0
MTM ENTERTAINMENT TRUST	MME	Hotel & Leisure	$12.190
STADIUM AUSTRALIA GROUP	SAX	Hotel & Leisure	$13.0
TOURISM & LEISURE	TLT	Hotel & Leisure	$14.0
AUST.HOTEL FUND	AHO	Hotel & Leisure	$23.0
GRAND HOTEL GROUP	GHG	Hotel & Leisure	$153.4
MACQUARIE LEISURE TRUST GP.	MLE	Hotel & Leisure	$165.1
THAKRAL HOLDINGS GROUP	THG	Hotel & Leisure	$386.7
DEUTSCHE INDL.TST.	DIT	Industrial	$656.2
ING INDL. FUND	IIF	Industrial	$1,300.9
MACQUARIE GOODMAN INDL.	MGI	Industrial	$2,712.8
ING OFFICE FUND	IOF	Office	$1,218.0
DEUTSCHE Office TST.	DOT	Office	$1,343.0
CARINDALE PROPERTY TST.	CDP	Retail	$182.7
PRIME RETAIL GROUP	PRX	Retail	$376.8
BUNNINGS WAREHOUSE	BWP	Retail	$471.9
MACQUARIE COUNTRY.TRUST	MCW	Retail	$1,142.8
CENTRO PROPS.GROUP	CEP	Retail	$2,743.5
CFS GANDEL RETAIL	GAN	Retail	$2,749.0
WESTFIELD AMERICA	WFA	Retail	$8,845.2
WESTFIELD TRUST	WFT	Retail	$9,829.8
WESTFIELD GROUP Stapled	WDC	Retail	$25,700.0

Table 2: Return Statistics for Listed Property Trusts

Company	Symbol	Category	Mkt Cap ($m)	M	S	V	CV	SK	K	JB TEST	SK TEST	K TEST	SV^-	SV^+	SV^-/SV^+
BIRON CAPITAL	BIC	Commercial	$14.0	0.0051	0.1120	0.0126	21.9500	-0.9497	6.0251	27.64478*	7.81706*	19.82772*	0.0074	0.0052	1.4106
FLEXI PROPERTY	FPF	Commercial	$69.5	0.0119	0.0320	0.0010	2.6834	0.7917	4.6040	11.00669*	5.43249*	5.57420*	0.0004	0.0006	0.6460
MACQUARIE OFFICE TRUST	MOF	Commercial	$1,157.7	0.0087	0.0247	0.0006	2.8372	-0.6768	3.7871	5.3124	3.97002*	1.3424	0.0004	0.0003	1.4026
RONIN PROPERTY GROUP	RPH	Commercial	$1,173.0	0.0075	0.0413	0.0017	5.4805	0.2178	3.9925	2.5452	0.4111	2.1341	0.0008	0.0009	0.9480
COMMONWEALTH PR.OFFE.FD.	CPA	Commercial	$1,738.5	0.0099	0.0287	0.0008	2.9010	-0.4814	2.4098	2.7633	2.0086	0.7547	0.0005	0.0003	1.3912
INVESTA PROPERTY GROUP	IPG	Commercial	$2,798.0	0.0123	0.0398	0.0016	3.2450	-0.6937	3.9865	6.27836*	4.17002*	2.1083	0.0009	0.0007	1.4099
TARAGON PROPERTY FUND	TPG	Diversified	$3.0	-0.0051	0.2248	0.0505	43.9967	0.3320	4.9934	9.56494*	0.9553	8.60962*	0.0241	0.0264	0.9138
MFS Leveraged Investment Group	MFS	Diversified	$36.0	0.0191	0.0810	0.0066	4.2300	-2.1986	13.5167	281.52939*	41.89351*	239.63588*	0.0043	0.0023	1.8614
ASPEN GROUP STAPLED	APZ	Diversified	$82.0	-0.0564	0.4509	0.2033	7.9946	-1.1799	11.3060	161.54248*	12.06508*	149.47740*	0.1198	0.0835	1.4346
JF MERIDIAN TRUST	JFM	Diversified	$486.6	0.0144	0.0415	0.0017	2.8884	0.4864	7.2627	41.41948*	2.0503	39.36914*	0.0008	0.0010	0.8155
DEUTSCHE DIVR.TST.	DDF	Diversified	$1,255.7	0.0048	0.0315	0.0010	6.6270	0.2557	3.1591	0.6213	0.5665	0.0548	0.0005	0.0005	0.9053
MIRVAC GROUP	MGR	Diversified	$3,128.8	0.0123	0.0340	0.0012	2.7622	-0.1987	6.9355	33.90017*	0.3420	33.55817*	0.0006	0.0006	1.0883
STOCKLAND	SGP	Diversified	$6,536.3	0.0150	0.0336	0.0011	2.2401	-0.7297	4.0595	7.04674*	4.61439*	2.4324	0.0007	0.0005	1.4272
GENERAL PR.TST.	GPT	Diversified	$7,018.2	0.0112	0.0326	0.0011	2.9066	0.6925	6.0854	24.78204*	4.15663*	20.62541*	0.0005	0.0006	0.8295
MFS LIVING AND LEISURE.	MPY	Hotel & Leisure	$4.0	-0.0190	0.2106	0.0443	11.0572	-1.1559	8.0453	66.73290*	11.57975*	55.15316*	0.0260	0.0183	1.4193
MTM ENTERTAINMENT TRUST	MME	Hotel & Leisure	$12.2	-0.0371	0.2345	0.0550	6.3258	-2.0399	11.8101	204.23824*	36.06522*	168.17302*	0.0364	0.0186	1.9537
STADIUM AUSTRALIA GROUP	SAX	Hotel & Leisure	$13.0	-0.0306	0.2799	0.0783	9.1572	0.7151	4.6442	10.28916*	4.43187*	5.85728*	0.0328	0.0455	0.7201
TOURISM & LEISURE	TLT	Hotel & Leisure	$14.0	0.0213	0.1504	0.0226	7.0474	-3.4247	26.1495	1262.76236*	101.64768*	1161.11468*	0.0160	0.0067	2.4005
AUST.HOTEL FUND	AHO	Hotel & Leisure	$23.0	-0.0066	0.0722	0.0052	10.8816	-0.2821	3.5913	1.4471	0.6896	0.7575	0.0028	0.0025	1.1293
GRAND HOTEL GROUP	GHG	Hotel & Leisure	$153.4	-0.0040	0.0845	0.0071	21.2340	-1.0461	5.5291	23.34218*	9.48404*	13.85815*	0.0044	0.0027	1.6350
MACQUARIE LEISURE TRUST GP.	MLE	Hotel & Leisure	$165.1	0.0151	0.0617	0.0038	4.0917	0.3479	4.6183	6.72314*	1.0491	5.67401*	0.0018	0.0020	0.8667
THAKRAL HOLDINGS GROUP	THG	Hotel & Leisure	$386.7	0.0051	0.0686	0.0047	13.3985	-1.1907	5.6742	27.78068*	12.28623*	15.49445*	0.0030	0.0017	1.7668
DEUTSCHE INDL.TST.	DIT	Industrial	$656.2	0.0127	0.0360	0.0013	2.8494	0.0585	2.2426	1.2724	0.0296	1.2428	0.0006	0.0007	0.9695
ING INDL. FUND	IIF	Industrial	$1,300.9	0.0098	0.0275	0.0008	2.7973	-0.1433	2.9273	0.1894	0.1780	0.0115	0.0004	0.0004	1.1365
MACQUARIE GOODMAN INDL.	MGI	Industrial	$2,712.8	0.0112	0.0258	0.0007	2.2986	-0.0496	2.4747	0.6193	0.0214	0.5980	0.0003	0.0003	1.0482
ING OFFICE FUND	IOF	Office	$1,218.0	0.0094	0.0268	0.0007	2.8454	-0.1382	1.8639	2.9623	0.1654	2.7968	0.0004	0.0003	1.0818
DEUTSCHE Office TST.	DOT	Office	$1,343.0	0.0057	0.0369	0.0014	6.5356	0.6642	2.6880	4.0341	3.8231	0.2110	0.0007	0.0007	0.9052
CARINDALE PROPERTY TST.	CDP	Retail	$182.7	0.0144	0.0515	0.0027	3.5767	-0.1346	2.5179	0.6605	0.1570	0.5036	0.0014	0.0013	1.0676
PRIME RETAIL GROUP	PRX	Retail	$376.8	0.0042	0.0677	0.0046	16.2891	-3.5946	21.5207	855.187*	111.9824*	743.2047*	0.0036	0.0010	3.4226
BUNNINGS WAREHOUSE	BWP	Retail	$471.9	0.0167	0.0380	0.0015	2.2719	-0.5231	2.9307	2.3814	2.3710	0.0104	0.0008	0.0006	1.3944
MACQUARIE COUNTRY.TRUST	MCW	Retail	$1,142.8	0.0124	0.0297	0.0009	2.4037	1.4340	2.3705	18.680*	17.82148*	0.8585	0.0004	0.0005	0.9008
CENTRO PROPS.GROUP	CEP	Retail	$2,743.5	0.0154	0.0312	0.0010	2.0236	-0.2238	3.9216	2.2744	0.4341	1.8403	0.0005	0.0005	1.0910
CFS GANDEL RETAIL	GAN	Retail	$2,749.0	0.0128	0.0347	0.0012	2.7036	-0.0438	3.6783	1.0135	0.0167	0.9968	0.0006	0.0006	0.9541
WESTFIELD AMERICA	WFA	Retail	$8,845.2	0.0152	0.0354	0.0013	2.3305	0.4172	3.3613	1.7911	1.5083	0.2828	0.0006	0.0007	0.8009
WESTFIELD TRUST	WFT	Retail	$9,829.8	0.0129	0.0359	0.0013	2.7898	-0.1999	2.9385	0.3545	0.3463	0.0082	0.0007	0.0006	1.1525
WESTFIELD GROUP Stapled	WDC	Retail	$25,700.0	0.0111	0.0593	0.0035	5.3382	0.7037	3.5383	4.9190	4.2911*	0.6279	0.0015	0.0021	0.7110

Explanatory Notes:

In the above table, M denotes the mean return, S the standard deviation, V the variance, CV the coefficient of variation, SK and K the 3rd and 4th moment measures of skew and kurtosis respectively. JB Test denotes the Jaquer-Bera normality test statistic and SK Test and K Test denote the modified Jaquer-Bera test statistics for skew and kurtosis respectively. All tests are conducted at the 5% significance level and the appearance of an asterisk alongside any test statistic indicates the result is significant at the 5% significance level. SV^+ and SV^- are the downside and upside semi-variance measures and SV^+/SV^- denotes their ratio.

Table 3: LPTs Sorted in Descending Order of (*SVR* = SV^{-}/SV^{+}) Ratio

Company	Symbol	Category	Mkt Cap ($m)	SK	SK TEST	SV^{-}/SV^{+}
PRIME RETAIL GROUP	PRX	Retail	376.8	-3.59459	111.98238*	3.42259
TOURISM & LEISURE	TLT	Hotel & Leisure	14	-3.4247	101.64768*	2.40053
MTM ENTERTAINMENT TRUST	MME	Hotel & Leisure	12.19	-2.03994	36.06522*	1.95372
MFS Leveraged Investment Group	MFS	Diversified	36	-2.19861	41.89351*	1.86142
THAKRAL HOLDINGS GROUP	THG	Hotel & Leisure	386.7	-1.19065	12.28623*	1.76683
GRAND HOTEL GROUP	GHG	Hotel & Leisure	153.4	-1.04609	9.48404*	1.63503
ASPEN GROUP STAPLED	APZ	Diversified	82	-1.17988	12.06508*	1.43461
STOCKLAND	SGP	Diversified	6536.3	-0.72968	4.61439*	1.42715
MFS LIVING AND LEISURE.	MPY	Hotel & Leisure	4	-1.15591	11.57975*	1.41929
BIRON CAPITAL	BIC	Commercial	14	-0.94972	7.81706*	1.41059
INVESTA PROPERTY GROUP	IPG	Commercial	2798	-0.69365	4.17002*	1.40987
MACQUARIE OFFICE TRUST	MOF	Commercial	1157.7	-0.67682	3.97002*	1.40263
BUNNINGS WAREHOUSE	BWP	Retail	471.9	-0.52305	2.371	1.39439
COMMONWEALTH PR.OFFE.FD.	CPA	Commercial	1738.5	-0.48141	2.00855	1.39118
WESTFIELD TRUST	WFT	Retail	9829.8	-0.1999	0.34632	1.15251
ING INDL. FUND	IIF	Industrial	1300.9	-0.1433	0.17796	1.13649
AUST.HOTEL FUND	AHO	Hotel & Leisure	23	-0.28209	0.68964	1.12932
CENTRO PROPS.GROUP	CEP	Retail	2743.5	-0.2238	0.4341	1.09102
MIRVAC GROUP	MGR	Diversified	3128.8	-0.19865	0.342	1.08832
ING OFFICE FUND	IOF	Office	1218	-0.13815	0.16542	1.0818
CARINDALE PROPERTY TST.	CDP	Retail	182.7	-0.13457	0.15695	1.0676
MACQUARIE GOODMAN INDL.	MGI	Industrial	2712.8	-0.04964	0.02136	1.04816
DEUTSCHE INDL.TST.	DIT	Industrial	656.2	0.05846	0.02962	0.96951
CFS GANDEL RETAIL	GAN	Retail	2749	-0.04384	0.01665	0.9541
RONIN PROPERTY GROUP	RPH	Commercial	1173	0.2178	0.41111	0.94795
TARAGON PROPERTY FUND	TPG	Diversified	3	0.33201	0.95532	0.91381
DEUTSCHE DIVR.TST.	DDF	Diversified	1255.7	0.25566	0.56648	0.90533
DEUTSCHE Office TST.	DOT	Office	1343	0.66417	3.82311	0.90516
MACQUARIE COUNTRY.TRUST	MCW	Retail	1142.8	1.43399	17.82148*	0.90078
MACQUARIE LEISURE TRUST GP.	MLE	Hotel & Leisure	165.1	0.34793	1.04913	0.86671
GENERAL PR.TST.	GPT	Diversified	7018.2	0.69254	4.15663*	0.82945
JF MERIDIAN TRUST	JFM	Diversified	486.6	0.48639	2.05034	0.81547
WESTFIELD AMERICA	WFA	Retail	8845.2	0.41717	1.50828	0.80086
STADIUM AUSTRALIA GROUP	SAX	Hotel & Leisure	13	0.7151	4.43187*	0.72014
WESTFIELD GROUP Stapled	WDC	Retail	25700	0.70365	4.29110*	0.71097
FLEXI PROPERTY	FPF	Commercial	69.5	0.79172	5.43249*	0.646

Table 4: Jaquer Bera Related Test Statistics and (SV^- / SV^+)Ratios for Equally Weighted & Market Weighted Portfolios

Company	Symbol	Category	Mkt Cap ($m)	SK	JB TEST	SK TEST	K TEST	SV^-	SV^+	SV^-/SV^+
Portfolio 1	P1	Portfolio - Equally Weighted *	75711.49	-0.56332	2.89178	2.75017	0.14161	0.00045	0.00031	1.46121
Portfolio 2	P2	Portfolio - Equally Weighted**	66866.29	-0.56234	2.85423	2.74062	0.11361	0.00043	0.00030	1.43564
Portfolio 3	P3	Portfolio - Market Weighted *	75711.49	-0.42236	2.57592	1.54603	1.02990	0.00035	0.00026	1.32176
Portfolio 4	P4	Portfolio - Market Weighted**	66866.29	-0.60546	3.63256	3.17709	0.45547	0.00042	0.00028	1.49466

* This portfolio excludes listed property trusts WFA and WFT but includes WDC
** This portfolio includes listed property trusts WFA and WFT but excludes WDC

Bibliography

Clarke, R. & Noble, A., 1999, "Property Allocations in Superannuation Funds", presentation to the Property Council of Australia Investment Series, May.

Clauretie, T. M. & Webb, J. R., 1993, ***The Theory and Practice of Real Estate Finance***, Dryden Press.

Grootveld, H., & Hallerbach, W., 1999, "Variance vs downside risk: is there really that much difference?", ***European Journal of Operational Research*** 114, pp.304-319

Jarque, C.M. and Bera, A.K., 1987, "A test for normality of observations and regression residuals", ***International Statistical Review***, 55, 163-72.

Markowitz, H., 1952, "Portfolio Selection", ***Journal of Finance***, 7 (1), pp. 77-91.

Webb, J.R. & Rubens, J.,1998, "The Effect of Alternative Return Measures on Restricted Mixed-Asset Portfolios," ***AREUEA Journal***, Vol.16, No.2, (1998)