This is the published version:


Available from Deakin Research Online:

http://hdl.handle.net/10536/DRO/DU:30021984

Reproduced with the kind permissions of the copyright owner.

Copyright : 2008, ARES
Executive Summary. This study examines the importance of downside beta when seeking to explain variations in listed property trust (LPT) returns in Australia between 1993 and 2005. The results reveal that downside beta outperforms conventional beta and provides higher explanatory power to the cross-sectional LPT return variations. The results also indicate that investors only require a premium for downside risk. However, the explanatory power of downside beta has diminished once the co-kurtosis of LPTs is controlled. Interestingly, the results also reveal that by itself downside beta is unable to fully explain returns in line with strong evidence for momentum and book-to-market ratio. The findings provide additional insights for investors and real estate analysts into the pricing of LPTs.

The determinants of cross-sectional return variations of listed property trusts (LPTs) or real estate investment trusts (REITs) have received considerable attention in recent finance and real estate literature. Early empirical studies focused on the ability of the Capital Asset Pricing Model (CAPM), particularly beta, to explain the return variations. CAPM was introduced by Sharpe (1964); since its introduction, it has become the most popular and widely used asset pricing model among practitioners and researchers.

However, CAPM is bound by several strict assumptions (e.g., the return distributions must be normally distributed). It should be noted that extensive studies have demonstrated that real estate return distributions are often skewed and with relatively large tails (Myer and Webb, 1993, 1994; Young and Graff, 1995; and Lu and Mei, 1999). Furthermore, CAPM also assumes that investors dislike upside and downside volatilities. Note this is not intuitively appealing since investors generally only dislike downside deviations; the deviations above the mean should be viewed as upside gains. In other words, investors generally only require a premium for compensating assets that have a high downside risk. On the other hand, investors do not necessarily require compensation for assets with a high upside potential. Therefore, it is not surprising that there is little empirical evidence to support the use of CAPM in the finance and real estate literature (Fama and French, 1992,
2004; Malkiel and Xu, 1997; and Conover, Friday, and Howton, 2000).

There have been various empirical contradictions about using CAPM since anomalies have been demonstrated in the stock and real estate markets. For example, Basu (1983) demonstrated that high earning/price ratio stocks are associated with higher returns. Similarly, Banz (1981) proved that relatively small stocks (i.e., based on market capitalization) are linked to higher returns. Chan, Hamao, and Lakonishok (1991) exhibited similar evidence with regards to the book-to-market ratio (B/M). In a different study, Fama and French (1992) provided further support for the importance of size and book-to-market ratio, concluding that these variables are important when explaining U.S. stock returns.

Following this debate about the relatively weak empirical support for CAPM and the rejection of strict assumptions, some alternative asset pricing models were proposed. One alternative model that has received considerable attention in recent literature is the Lower Partial Moment-CAPM (LPM-CAPM) or downside beta. This was first introduced by Hogsten and Warren (1974) and Bawa and Linderberg (1977) on the belief that risk was only related to downside losses and also that it must be able to capture the asymmetry in returns. More importantly, further evidence in favor of LPM-CAPM and downside beta in comparison to CAPM and beta has also been demonstrated in recent finance literature (Post and Vilet, 2004; and Ang, Chen, and Xing, 2006).

Overall there has been little, if any, real estate research that has comprehensively explored the ability of downside beta to explain cross-sectional variation in LPT returns. Therefore, this paper investigates the importance of LPM-CAPM, notably downside beta, in explaining the cross-sectional variations in Australian LPT returns. In particular, there are three important contributions from this study. First, despite earlier studies into downside beta in the stock market, relatively little attention has been placed on the LPT or REIT market. Recent studies have demonstrated that the characteristics of LPTs or REITs have switched from stocks to real estate (Liang and McIntosh, 1998; Clayton and Mackinnon, 2001; and Newell and Acheampong, 2001). If LPTs or REITs are viewed as a different type of asset in contrast to shares, then an examination specifically for LPTs or REITs is essential. This study also builds upon previous research conducted by Cheng (2005) where the explanatory power of downside beta was further controlled by LPT firm characteristics and momentum effects. Moreover, four-moment (co-kurtosis) analysis is also introduced in investigating the significance of downside beta in explaining cross-sectional variations of LPT returns. The findings from this research will assist investors and fund managers with assessing the usefulness of downside beta in pricing LPTs, as well as providing an enhanced understanding about the market-related risks associated with LPTs.

The balance of this paper is organized as follows. Next there is a review of the finance and real estate literature on the determinants of LPT returns, followed by a discussion of the data and methodology. The empirical results are then reported and discussed. The paper closes with concluding remarks.

Literature Review

According to CAPM, there is a direct association between systematic risk (beta) and returns where the beta is the only variable in asset pricing. However, extensive studies have failed to confirm the ability of beta to explain stock returns. McIntosh, Liang, and Tompkins (1991) identified an insignificant relationship between U.S. REIT returns and beta during 1974–1988, with similar results from studies conducted by Chen, Hsieh, and Chiou (1998) and Conover, Friday, and Howton (2000). Recently, Chiang, Lee, and Wisen (2005) concluded that beta has weak explanatory power in relation to variations in U.S. REIT returns. These results were also confirmed by Cheng (2005) in which beta was negatively and insignificantly related to U.S. direct property returns. Similarly in Australia, Kishore (2004) examined the appropriateness of CAPM in Australian LPTs and concluded that
CAPM failed to identify a relationship between risk and return. Therefore, the assumption that market beta is suitable for explaining return variations in CAPM is questionable.

Other issues associated with the empirical contradictions of CAPM are also well-documented. Li and Wang (2005) provided some indirect evidence in which they found that the smaller REITs (based on market capitalization) have higher returns in comparison to the largest REITs. Chen, Hsieh, and Chiou (1998) also highlighted the importance of the size factor in REIT asset pricing. Their findings confirmed a significant and negative relationship between return and size in U.S. REITs from 1978 to 1994. More importantly, they found that size was the sole consistent factor in explaining return. Interestingly, Chiang, Lee, and Wisen (2004, 2005) employed the Fama and French (1993) three-factor model and found a size effect in U.S. REITs. Moreover, the effect of book-to-market ratio was also evident in their studies. Similarly, Kishore (2004) also employed the Fama and French three-factor model in Australian LPTs and found that size and book-to-market ratio were statistically significant when related to LPT returns. Ooi and Liow (2004) focused on Asian markets and also presented evidence that there was a relationship between the small firm and high book-to-market ratio effects in risk-adjusted Asian real estate stock returns.

Conover, Friday, and Howton (2000) demonstrated a negative correlation between size and returns, while its significance varied from model to model. They also found a statistically insignificant relationship between book-to-market ratio and returns. Interestingly, their results concluded that both variables were not significant in bull markets. Chui, Titman, and Wei (2003a) found positive but statistically insignificant relationships between return, size, and book-to-market ratio; in addition, they identified a significant relationship between turnover effect and momentum effect in expected U.S. REIT returns.

Momentum effect was first introduced by Jegadeesh and Titman (1993) based on the premise that past winners will continue to outperform losers over a short-term period. Stevenson (2002) has also found momentum effect on a short-term basis in international real estate securities. Comparable evidence was found by Glascock and Hung (2005) in which they confirmed momentum profits in U.S. REITs by utilizing a longer time-series (1972–2000). These results are consistent with the recent finance literature (see Ang, Chen, and Xing, 2006) in which it has been demonstrated that momentum strategy can be used to explain expected returns of U.S. stock markets.

In regards to the poor empirical support for beta, numerous studies have highlighted the importance of incorporating market conditions to examine beta. The focus was placed on a time-varying CAPM model in which beta is decomposed into up and down market betas (Bhardwaj and Brooks, 1993). Conover, Friday, and Howton (2000) adopted a similar methodology and found that beta is significant in explaining REIT returns during bull markets, although there is no similar evidence in bear markets. Chiang, Lee, and Wisen (2004) documented similar asymmetric results for U.S. REIT betas in two different market conditions and concluded that beta could mislead investors if traditional CAPM is employed. Overall, these studies have provided indirect evidence to support the importance of adopting an asymmetric risk measure in asset pricing.

Recently, downside beta, an asymmetric risk measure computed by using LPM-CAPM, has received extensive attention in the finance literature. This model is viewed as a more intuitively appealing asset pricing model in that it only focuses on the downside risk of an asset. Moreover, LPM-CAPM does not require normality assumptions and constant utility function assumptions in comparison with CAPM (Nawrocki, 1999; and Estrada, 2002). Importantly, this asset pricing model is able to capture the asymmetric and relatively large tails in returns (Bawa and Linderberg, 1977; and Harlow and Rao, 1989).

Several studies have also demonstrated the importance of downside beta in asset pricing and risk management. Price, Price, and Nantell (1982) revealed that beta and downside beta are empirically distinguishable if return distributions are log-
normally distributed. This is consistent with the results from Nantell, Price, and Price (1982) in which they demonstrated that LPM-CAPM and CAPM models provide divergence of results if skewness is found. These results are consistent with the findings from Galagedera (2007), which confirmed that return distributions have an effect on the association between beta and downside beta. This can be used to explain why downside beta usually performs better than traditional beta in emerging markets.

Importantly, Pedersen and Hwang (2002) concluded that CAPM can be rejected in approximately 30%–50% of cases if the return distributions are in asymmetric form. Furthermore, the results also showed that LPM-CAPM should be the preferred option as an alternative to CAPM. Pedersen and Hwang (2003) extended their previous study to examine the explanatory power of downside beta in U.K. equity returns. Although they found that downside beta generally has higher explanatory power than the traditional beta, the improvements were marginal. In contrast, Estrada (2002) demonstrated that downside beta outperforms traditional beta when seeking to explain the variations of returns in emerging stock markets.

Post and Vilet (2004) argued that downside beta has higher exploratory power than traditional beta when explaining U.S. stock returns. Ang, Chen, and Xing (2006) supported these results and confirmed that downside beta has higher explanatory power in U.S. stock returns than traditional beta. Most importantly, they concluded that U.S. stock investors only require a risk premium for downside beta and there was no similar evidence for upside beta. In a real estate context, Cheng (2005) found similar results for U.S. direct property returns in which downside beta had significantly higher explanatory power than conventional beta.

Following this review of the literature, the ability of beta to explain returns appears to be unreliable. As noted, numerous studies suggest employing downside beta rather than beta. Although extensive studies have demonstrated the importance of downside beta in stock market asset pricing, relatively little attention has been placed on LPT returns.

Data and Methodology

This study examined all LPTs listed on the Australian Stock Exchange (ASX) from 1993 to 2005. The LPTs were identified by using the Global Industry Classification Standard (GICS) and ASX Sub-Code over the study period. Monthly returns, market capitalization, numbers of shares traded, and shares outstanding relating to all LPTs were obtained from Bloomberg. Any missing data were found manually by reference to Share Magazine. Note that the ASX All Ordinaries Price Index was used as proxy for the market, where the proxy for the risk-free rate was the one month interbank rate. Both indicators were extracted from DataStream.

An LPT was only retained in the analysis if the monthly returns for the LPT were available at least 24 months and there is sufficient information for the other variables. This is consistent with methodology adopted by Fama and French (1992) and Chui, Titman, and Wei (2003a). In the same manner as Chui et al. (2003a), the firm size of a LPT in month \( t \) is its market capitalization at the end of that month. Turnover is calculated as the ratio of its total number of shares traded to its shares outstanding in that month. The book-to-market ratio for each REIT is computed as its most updated book value in year \( t - 1 \) divided by its market capitalization. All book-to-market ratios are set equal to 1% and 99% levels in order to minimize the effect of extreme B/M ratios.

The monthly returns of all individual LPTs were used to estimate the beta of the LPTs. Consistent with Fama and French (1992), a LPT’s beta was estimated based on at least 24 of 60 months of monthly returns. Beta can be computed as follows:

\[
\beta_i = \frac{Cov(R_i, R_m)}{Var(R_m)},
\]

(1)

where \( Cov(R_i, R_m) \) is the covariance between asset \( i \) and market \( m \), and \( Var(R_m) \) is the variance of the market returns.

Thereafter, the data were also used to estimate the downside beta of LPTs. Downside beta (\( \beta^- \)) is estimated by using Estrada’s (2002) definition:
Downside Beta and the Cross-sectional Determinants of Listed Property Trust Returns

\[
\beta_i^- = \frac{\text{Cov}(R_i, R_m | R_m < \mu_m)}{\text{Var}(R_m | R_m < \mu_m)} = \frac{E[\text{Min}[(R_i - \mu_i), 0]|\text{Min}[(R_m - \mu_m), 0]]}{E[\text{Min}[(R_m - \mu_m), 0]^2]}, \tag{2}
\]

where \(\mu_i\) and \(\mu_m\) are the benchmarks for asset \(i\) and the market \(m\), respectively.

Similarly to Ang, Chen, and Xing (2006), upside beta \((\beta_i^+)^\) is measured as follows:

\[
\beta_i^+ = \frac{\text{Cov}(R_i, R_m | R_m > \mu_m)}{\text{Var}(R_m | R_m > \mu_m)}. \tag{3}
\]

Summary statistics of all computational results are presented in Exhibit 1.

Fama and MacBeth (1973) regressions were employed to estimate the monthly cross-sectional regressions as follows:

\[
R_{it} = \alpha + \phi_p \beta_{i,t-1} + \phi_{DB} \beta_{i,t-1} + \phi_{UB} \beta_{i,t-1} + \phi_{L} \ln(\text{Size})_{it-1} + \phi_{BM} B/M_{it-1} + \phi_{LT} \ln(\text{Turnover})_{it-1} + R_{i,t-12} + e_{it}, \tag{4}
\]

where \(\beta_{i,t-1}\) is the beta of LPT \(i\) at the end of month \(t - 1\). The purpose of skipping one month is for eliminating the bid-ask bounce effect. This is consistent with Chui, Titman, and Wei (2003a). \(\beta_{i,t-1}\) is the downside beta of LPT \(i\) at the end of month \(t - 1\). \(\beta_{i,t-1}^+\) is the upside beta of LPT \(i\) at the end of month \(t - 1\). \(\ln(\text{Size})_{it-1}\) is the natural logarithm of market capitalization of LPT \(i\) at the end of month \(t - 1\). \(B/M_{it-1}\) is the book-to-market ratio (B/M) of LPT \(i\) at the end of month \(t - 1\). \(\ln(\text{Turnover})_{it-1}\) is the natural logarithm of turnover of LPT \(i\) at the end of month \(t - 1\). \(R_{i,t-12}\) is the past 12-month returns of LPT \(i\) at the end of month \(t - 1\).

Results and Discussion

Normality Tests

An examination on the normality of individual LPTs was conducted. This examination is supported by recent literature that downside beta appears as a more efficient risk measure if return distributions are in asymmetrical form.

Three different normality tests were employed—Jarque-Bera, Lilliefors, and Shapiro-Wilk—with the results reported in Exhibit 2. It is apparent that the returns for LPTs are not normally distributed due to the strong normality rejection results. The Jarque-Bera test revealed that more than half of LPTs in the sample are not normally distributed. However, these results are not surprising since the individual LPT return distributions are, in general, highly peaked and positively skewed.

### Exhibit 1
Summary Statistics for the LPTs Sample

<table>
<thead>
<tr>
<th>Summary</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Dev.</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size (in million AS)</td>
<td>674.553</td>
<td>262.408</td>
<td>118.369</td>
<td>9961.782</td>
<td>865.500</td>
<td>3.633</td>
</tr>
<tr>
<td>Book-to-Market Ratio (B/M)</td>
<td>1.417</td>
<td>1.006</td>
<td>4.633</td>
<td>109.890</td>
<td>0.224</td>
<td>20.269</td>
</tr>
<tr>
<td>Turnover</td>
<td>0.032</td>
<td>0.024</td>
<td>0.041</td>
<td>1.748</td>
<td>0.000</td>
<td>14.967</td>
</tr>
<tr>
<td>Past 12-months Return</td>
<td>0.141</td>
<td>0.074</td>
<td>0.594</td>
<td>9.785</td>
<td>-1.112</td>
<td>10.060</td>
</tr>
<tr>
<td>Beta</td>
<td>0.372</td>
<td>0.377</td>
<td>0.743</td>
<td>3.207</td>
<td>-7.394</td>
<td>-3.963</td>
</tr>
<tr>
<td>Downside Beta</td>
<td>0.333</td>
<td>0.307</td>
<td>0.280</td>
<td>1.760</td>
<td>-1.202</td>
<td>0.797</td>
</tr>
<tr>
<td>Upside Beta</td>
<td>0.305</td>
<td>0.235</td>
<td>0.995</td>
<td>8.049</td>
<td>-7.609</td>
<td>1.191</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.666</td>
<td>0.171</td>
<td>1.834</td>
<td>7.730</td>
<td>-3.910</td>
<td>2.636</td>
</tr>
<tr>
<td>Co-kurtosis</td>
<td>47.593</td>
<td>37.854</td>
<td>45.616</td>
<td>286.036</td>
<td>-174.390</td>
<td>0.228</td>
</tr>
</tbody>
</table>

Note: The number of observations is 68.
It should be noted that the Lilliefors and Shapiro-Wilk tests confirmed that about half of the Australian LPTs in the sample are not normally distributed, where the normality assumptions can be rejected at least at the 5% level. These findings confirm that most Australian LPTs are not normally distributed. These results are consistent with previous studies where real estate return distributions, either in emerging or developed markets, are not necessarily normally distributed. More importantly, these also support the use of asymmetric risk measures over traditional risk measures. Consequently, the appropriateness of using beta in LPTs is questionable.

### Beta and Firm Characteristics

Exhibit 3 presents the coefficient estimates and the t-statistics of the cross-sectional regressions of beta and firm characteristics in LPT returns. Consistent with previous studies, the ability of beta in explaining LPT returns is questionable. Model I shows that there is no evidence to support the position that beta can explain LPT returns. This confirms the findings of many previous studies where CAPM was rejected in the REIT or LPT markets. A plausible explanation of this failure is the presence of non-normality in the LPT return distributions and beta fails to capture this asymmetric.

When additional variables (e.g., size, book-to-market ratio, turnover, and momentum) are included in Model II, the coefficient on beta remains statistically insignificant. This result provides further support highlighting the inability of beta to fully explain returns. Conversely, the regressions results in Models II and III also provide several anomalies that are documented in the literature. For instance, a strong positive relationship between book-to-market ratio and LPT returns is evident. In regressions in Models II and III, book-to-market ratio is positive and statistically significant at 1%. These indicate that higher book-to-market ratio LPTs have higher returns. These results are also consistent with previous studies in REIT or LPT literature (see Chiang, Lee, and Wisen, 2004, 2005).

The cross-sectional regressions also show that larger LPTs outperform smaller LPTs based on market capitalization. Nevertheless, the evidence to support the predictive power of size is marginal. This confirms results from Chui, Titman, and Wei (2003a) for U.S. REITs in which the size effect has diminished in recent years. On the other hand, these results differ to previous findings based on Australian LPTs (i.e., Kishore, 2004), although different methodologies and time periods could be the possible explanations for the variations. Kishore (2004) focused on aggregate performance of LPTs.
in which he constructed several indices and employed the Fama and French (1993) three-factor model in analyzing data from 1992 to 2002. In this study, Fama and MacBeth (1973) cross-sectional regressions were employed to examine the importance of these factors on individually basis.

Moreover, it is clear that the past 12-month returns have a strong explanatory power for LPT returns, where its coefficient is positive and statistically significant at 1%. This indicates that 'winner' LPTs over the past 12 months will continue to perform well. This is consistent with the findings on momentum effect in U.S. REITs (Chui, Titman, and Wei, 2003a; and Glascock and Hung, 2005). Nevertheless, there is no similar evidence to support turnover. A negative relationship between turnover and LPT returns is evident, although its coefficient is statistically insignificant.

In summary, momentum and book-to-market ratio have strong explanatory powers when explaining LPT returns. However similar results were not found for other characteristics and the traditional systematic risk measure (beta), therefore an alternative systematic risk measure should be considered.

**Downside Beta**

Due to the strong evidence supporting non-normality in LPT return distributions from Exhibit 2 and weak support for beta in Exhibit 3, the beta was replaced by downside beta to examine the suitability of downside beta to explain LPT returns. The results of this analysis are shown in Exhibit 4.

Beta is replaced by downside beta in Regression I in Exhibit 4, where the coefficient on the downside beta is positive, although it is statistically insignificant in relation to returns. On the other hand, the coefficient on the upside beta in Model II is negative but also statistically insignificant. These results are intuitive and show that investors dislike downside losses and require a risk premium for holding assets with high downside risk, while there is a discount for upside beta that measures the exposure to a rising market. However, these coefficients are not statistically significant. One possible explanation is the difficulty associated with separating the effect of downside beta and upside beta. Ang, Chen, and Xing (2006) argued that it was hard to determine whether higher realized returns are contributed by exposure to downside risk or as a result of upside gains. Besides, it also implies that the variations in LPT returns cannot be fully explained by downside beta.

Models III and IV in Exhibit 4 display the results of the downside beta model after including other firm-specific variables. Clearly the coefficient on the downside beta remains positive and significant at 5% when additional variables are included. These results are consistent with the results from U.S. direct property and U.S. stock markets, where the premium for downside beta is positive and statistically significant. More importantly, the coefficient of upside beta is insignificant. This supports findings from previous studies (e.g., Ang, Chen, and Xing, 2006), where only downside beta is priced by investors, while no similar evidence for upside beta is found. This suggests that investors only require a risk premium for accepting downside risk.

---

**Exhibit 4**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Model</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.010</td>
<td>0.035</td>
<td>-1.694</td>
<td>-1.459</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.946)</td>
<td>(2.552)</td>
<td>(-1.502)</td>
<td>(-1.355)</td>
<td></td>
</tr>
<tr>
<td>Downside Beta</td>
<td>0.006</td>
<td>0.108</td>
<td>0.1417</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.165)</td>
<td>(2.247)**</td>
<td>(2.413)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upside Beta</td>
<td>-0.021</td>
<td>-0.0147</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.649)</td>
<td>(-0.692)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln(Size)</td>
<td>0.0771</td>
<td>0.0539</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.341)</td>
<td>(0.958)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Book-to-Market Ratio</td>
<td>0.2976</td>
<td>0.2919</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(5.973)**</td>
<td>(6.129)**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln(Turnover)</td>
<td>0.0034</td>
<td>0.0038</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.643)</td>
<td>(0.740)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Past 12-month Returns</td>
<td>0.0435</td>
<td>0.0453</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.293)**</td>
<td>(3.495)**</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: B/M is restricted at the 1% level and at the 99% in order to minimize the effect caused by extreme B/M ratios.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.
The regression results for firm-specific variables in Models III and IV in Exhibit 4 are also consistent with the previous results in Exhibit 2 where there are only two variables (B/M and momentum) that have strong explanatory powers in explaining cross-sectional variations of LPT returns. These indicate that high book-to-market ratio LPTs have significantly higher returns than LPTs with low book-to-market ratios. Furthermore, this study also confirms the importance of the momentum strategy in LPTs to explain LPT returns being statically significant at 1%.

In summary, there is clear evidence to support the view that downside beta is priced by investors in LPTs. Consistent with previous studies, no evidence was identified to support upside beta. Interestingly, the importance of momentum and book-to-market ratios are also found in downside beta models, which confirms that downside beta cannot fully explain or capture the variations in LPT returns.

Higher-moment

There are several concerns that need to be addressed in this study, with one concern being higher-moment orders. A large body of literature suggests incorporating higher moments (skewness and kurtosis) or higher co-moments (co-skewness and co-kurtosis) in asset pricing if the return distributions are not normally distributed. Kraus and Litzenberger (1976) was most likely the first study to examine the impact of higher moments in stock returns. The authors found that co-skewness is priced if the return distribution is not normally distributed. More recently, Harvey and Siddique (2000) also argued that co-skewness is useful in explaining the variations of stock returns.

Hwang and Satchell (1999) employed Generalized Method of Moments (GMM) in emerging stock markets and found evidence to support the importance of co-skewness and co-kurtosis in explaining returns. However, Chi, Hung, Shackleton, and Xu (2004) employed a non-linear model for examining the impacts of co-skewness and co-kurtosis in UK stocks. Their findings revealed little evidence for the existence of an association between higher order pricing factors and co-skewness and co-kurtosis, respectively. Galagedera, Henry, and Silvapulle (2003) examined the ability of symmetric higher-order co-moments to explain cross-sectional Australian security returns corresponding to rising and falling markets. Their findings concluded that co-skewness appears to be priced, although there was no evidence to show that co-kurtosis is priced.

In the real estate literature, Liu, Hartzell, and Grissom (1992) examined the implications of third-order moments in asset pricing and concluded that co-skewness provides some explanatory power for commingled real estate fund returns. However, Vines, Hsieh, and Hatem (1994) failed to find strong empirical evidence for co-skewness as a determinant of REIT returns. Similar results were found by Cheng (2005) for U.S. NCREIF property returns. Nevertheless, it was concluded that skewness can be used to explain the cross-sectional variation of NCREIF property returns. More importantly, it was argued that skewness captures some additional aspects of downside losses in asset variations. More recently, Liow and Chan (2005) supported the role of co-skewness and co-kurtosis in global real estate securities pricing. They found that co-kurtosis provides a higher explanatory power than co-skewness in explaining global real estate securities returns. Therefore, in this study, downside beta is also further controlled by skewness, co-skewness, and co-kurtosis in line with these higher moment asymmetric risks, which have been argued are able to capture the asymmetry of the return distributions.

The co-skewness and co-kurtosis of LPTs are computed by using the definition of Ang, Chen, and Xing (2006) as follows:

\[
\text{COSkew}_i = \frac{E[(R_i - \mu_i)(R_m - \mu_m)]}{\sqrt{\text{Var}(R_i)\text{Var}(R_m)}},
\]

(5)

\[
\text{COKurt}_i = \frac{E[(R_i - \mu_i)(R_m - \mu_m)^3]}{\sqrt{\text{Var}(R_i)\text{Var}(R_m)^{3/2}}}. \quad (6)
\]

Skewness is commonly computed as:

\[
\text{Skew}_i = \frac{n}{(n - 1)(n - 2)} \sum \left( \frac{R_i - E(R_i)}{s} \right)^3,
\]

(7)

where \( n \) is the sample size, \( s \) is the standard deviation, and \( R_i \) is the return of asset \( i \).
The Fama and MacBeth (1973) regression model in Equation (4) is further employed by incorporating co-skewness, co-kurtosis, and skewness, respectively. The regression is presented as follows:

\[
R_{i,t} = \alpha + \phi_{DB} \beta_{i,t-1} + \phi_{UB} \beta_{i,t-1} + \phi_{DBD} \beta_{i,t-1} \\
+ \phi_{Ln(\text{Size})} \beta_{i,t-1} + \phi_{BM} \beta_{i,t-1} \\
+ \phi_{Ln(\text{Turnover})} \beta_{i,t-1} + R_{i,t-1} \\
+ \phi_{COSkew} \beta_{i,t-1} + \phi_{COKurt} \beta_{i,t-1} \\
+ \phi_{Skew} \beta_{i,t-1} + \epsilon_i.
\] (8)

\(COSkew_{i,t-1}\) is the co-skewness of LPT \(i\) at the end of month \(t - 1\). \(COKurt_{i,t-1}\) is the co-kurtosis of LPT \(i\) at the end of month \(t - 1\). \(Skew_{i,t-1}\) is the skewness of LPT at the end of month \(t - 1\). The results are shown in Exhibit 5.

In Regression I, skewness is introduced into the downside risk models in Exhibit 4. The results depict that downside beta remains positive and statistically significant at the 5% level even after controlling for skewness. No improvement was evident for upside beta and no substantial changes were found in the coefficients for the other variables. The weak influence of skewness is not surprising since the skewness is statistically insignificant. Interestingly, the coefficient of skewness is positive and consistent with the finding of Cheng (2005), indicating that higher skewness is associated with a higher risk premium.

Consistent with Ang, Chen, and Xing (2006) for U.S. stock returns, controlling for co-skewness reduces the significance of downside beta from 0.142 in Model IV (Exhibit 4) to 0.123 in Regression II (Exhibit 5). Even so, a positive premium for the return of LPT is still observed after controlling for skewness.

### Exhibit 5

**Fama-MacBeth Regressions of Firm Characteristics, Downside Beta, and Asymmetric Risk Measures on LPT Returns**

<table>
<thead>
<tr>
<th>Model</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-1.187</td>
<td>-1.083</td>
<td>-1.379</td>
<td>-1.383</td>
<td>-1.074</td>
<td>-1.133</td>
</tr>
<tr>
<td>Beta</td>
<td>(-1.038)</td>
<td>(-0.670)</td>
<td>(-1.031)</td>
<td>(-1.050)</td>
<td>(-0.793)</td>
<td>(-0.879)</td>
</tr>
<tr>
<td>Downside Beta</td>
<td>0.1412</td>
<td>0.1229</td>
<td>0.0926</td>
<td>0.1084</td>
<td>0.1120</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.408)**</td>
<td>(1.866)*</td>
<td>(1.428)</td>
<td>(1.729)*</td>
<td>(1.583)</td>
<td></td>
</tr>
<tr>
<td>Upside Beta</td>
<td>-0.0123</td>
<td>0.0191</td>
<td>0.0110</td>
<td>0.0094</td>
<td>0.0211</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.449)</td>
<td>(0.859)</td>
<td>(0.405)</td>
<td>(0.337)</td>
<td>(0.679)</td>
<td></td>
</tr>
<tr>
<td>Ln(Size)</td>
<td>0.0516</td>
<td>0.0293</td>
<td>0.0582</td>
<td>0.0609</td>
<td>0.0402</td>
<td>0.0424</td>
</tr>
<tr>
<td></td>
<td>(0.881)</td>
<td>(0.468)</td>
<td>(0.850)</td>
<td>(0.904)</td>
<td>(0.585)</td>
<td>(0.656)</td>
</tr>
<tr>
<td>Book-to-Market Ratio (B/M)</td>
<td>0.3093</td>
<td>0.2925</td>
<td>0.3214</td>
<td>0.3320</td>
<td>0.3195</td>
<td>0.2990</td>
</tr>
<tr>
<td>Ln(Turnover)</td>
<td>0.0043</td>
<td>0.0025</td>
<td>0.0057</td>
<td>0.0046</td>
<td>0.0019</td>
<td>0.0029</td>
</tr>
<tr>
<td></td>
<td>(0.711)</td>
<td>(0.498)</td>
<td>(0.786)</td>
<td>(0.755)</td>
<td>(0.366)</td>
<td>(0.552)</td>
</tr>
<tr>
<td>Past 12-month Returns</td>
<td>0.0442</td>
<td>0.0583</td>
<td>0.0507</td>
<td>0.0468</td>
<td>0.0067</td>
<td>0.0527</td>
</tr>
<tr>
<td></td>
<td>(2.813)**</td>
<td>(4.603)**</td>
<td>(3.567)**</td>
<td>(2.897)**</td>
<td>(4.124)**</td>
<td>(3.730)**</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.0010</td>
<td>-0.0103</td>
<td>-0.0193</td>
<td>-0.0103</td>
<td>-0.0103</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.054)</td>
<td>(0.685)</td>
<td>(0.685)</td>
<td>(0.685)</td>
<td>(0.685)</td>
<td></td>
</tr>
<tr>
<td>Co-skewness</td>
<td>-0.004</td>
<td>0.0025</td>
<td>0.0016</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.204)</td>
<td>(0.758)</td>
<td>(0.975)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-kurtosis</td>
<td>0.0099</td>
<td>0.0005</td>
<td>0.0025</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.876)</td>
<td>(0.624)</td>
<td>(0.570)</td>
<td>(1.527)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: B/M is restricted at the 1% level and at the 99% in order to minimize the effect caused by extreme B/M ratios.

* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.
downside beta was found to be statically significant at 10%. In contrast, the results from Regression III (Exhibit 5) reveal that the explanatory power of downside beta in LPTs disappears once the co-kurtosis of LPTs is controlled. Although the positive premium for downside beta is still evident in Regression III, it is statistically insignificant. In Regressions IV and V in Exhibit 5, downside beta and upside beta are further controlled by two additional asymmetric risk measures simultaneously. Clearly, downside beta is not affected significantly by combining skewness and co-kurtosis in the model. It has the right positive sign and remains statistically significant at 10%. Conversely, the significance of downside beta has disappeared once it is controlled by co-kurtosis and co-skewness. The beta is also controlled by asymmetric risk measures, while beta remains insignificant, as indicated in Model VI. Another interesting observation from Exhibit 5 is that the importance of the momentum and book-to-market ratio variables is highlighted. Both variables are consistent and statistically significant in all regressions, and most importantly, no improvement is found in the other insignificant firm-specific variables.

It should be noted that none of the coefficients of additional asymmetric risk measures were significant. The insignificance of co-skewness is expected and it confirms the previous findings for U.S. REITs, while the insignificance of co-kurtosis is also consistent with indirect evidence from Liow and Chan (2005) for Australian real estate securities in global perspectives and Galagedera, Henry, and Silvapulle (2003) for the Australian stock market. However, the insignificance results of skewness are in direct contrast with the findings from Cheng (2005). Different real estate investment vehicles could perhaps be the reason for this divergence. In other words, these results have also provided some indirect evidence that the return-generating process for LPT/REIT returns could be different from direct property returns.

Overall, Exhibit 5 confirms that downside beta is consistently significant in explaining LPT returns. Similar significant results are also evident for book-to-market ratio and momentum in Exhibit 5. In general, downside beta outperforms the traditional beta where there is evidence to support it being used to explain LPT returns. Once the co-kurtosis of LPTs is controlled, however, the importance of downside beta has vanished. Note that little evidence was found to support the importance of other asymmetric risk measures in LPT asset pricing. More importantly, the results also reveal that the higher-moment (skewness, co-skewness, and co-kurtosis) extensions into the models only have influence on the significance of downside beta. These indicate that downside beta and higher moment asymmetric risk measures might capture similar variations.

Co-kurtosis, Co-skewness, and Downside Beta

An important observation from Exhibit 5 is that the explanatory power of downside beta has disappeared once the co-kurtosis of LPTs is controlled. One of the explanations is that both measures might capture some similar asymmetric higher moments or downside losses of LPTs, where this scenario is demonstrated in this section. First, at the end of each month, all LPTs in the sample are equally-weighted and sorted into three groups based on their downside beta, namely as low, medium, and high groups. Within each group, the co-kurtosis of all LPTs is then averaged. Similar procedures are repeated for co-skewness and co-skewness, respectively, where Exhibit 6 shows the results.

It is clear from Panel A in Exhibit 6 that co-kurtosis increases monotonically with downside beta. The low downside beta group has the lowest co-kurtosis; co-kurtosis is higher in high downside beta group. In addition, a negative trend was identified between co-skewness and downside beta, where the low downside beta group has the highest co-skewness while the high downside beta group has the lowest co-skewness.

More importantly, Panel B of Exhibit 6 also presents a clear monotonic increase and decrease for downside beta and co-skewness, respectively, once controlled for co-kurtosis. Interestingly, once co-skewness is controlled in Panel C, a decreasing trend was found for downside beta and co-kurtosis.
These findings demonstrate that high downside beta LPTs have higher co-kurtosis and lower co-skewness and vice versa. As such, it is not surprising that the inclusion of co-kurtosis and co-skewness will lower the significance of downside beta.

**Robustness Checks**

To reinforce these findings, the baseline results for downside beta were further examined with the impact of different target rates of return. Downside beta was further measured by two commonly used target rates, namely the risk free rate and the zero target rate of return. Exhibit 7 presents the results.

Clearly no substantial difference was found by changing target rates of return to risk-free and zero. In Panel A of Exhibit 7, downside beta is measured with the risk-free target rate, where the results show that downside beta coefficients were statistically significant at the 5% level over all models. In addition, upside betas were statistically insignificant, which confirms the results from Exhibit 4 where only downside beta was priced by investors. More importantly, little evidence was available to support the view that investors require a premium for upside beta. Similar results are indicated in Panel B, where downside beta is measured by the zero target rate of return.

Another interesting observation from Exhibit 7 is that the significance of other factors was not influenced by adopting different target rates of return for downside beta. Book-to-market ratios and past 12-month returns are significant factors when seeking to explain Australian LPT returns. In addition, no improvement was found for the significance of size and turnover factors, as these factors do not exhibit strong explanatory power in explaining cross-sectional variations in LPT returns. In summary, the results from Exhibit 4 are robust with regard to changing target rates of return for downside beta.

**Conclusion**

The importance of CAPM is an ongoing debate where extensive empirical evidence has shown...
that beta fails to explain return variations. Therefore, there is a growing body of literature supporting the use of LPM-CAPM to measure downside systematic risk (downside beta) for a stock. In this paper, the appropriateness of using downside beta in explaining cross-sectional variations of Australian LPTs was examined.

There are several important findings from this study. First, the results confirm that downside beta outperforms traditional beta in explaining the cross-sectional variations of LPT returns. It was demonstrated that downside beta can explain LPT returns, while no evidence is found for traditional beta. Second, the results also show that downside beta is positive and statistically significant, while the coefficient for upside beta is negative and statistically insignificant. These findings show that investors require compensation for bearing with downside beta, whereas they do not necessarily require a premium for upside beta. These findings are consistent with the recent finance literature and the results provide further support for the importance of LPM-CAPM. Third, the results confirm the existence of a positive and statistically significant relationship between LPT returns, the book-to-market ratios, and the past 12-month returns. In other words, high book-to-market ratio (B/M) LPTs and high past return LPTs will provide higher returns. Importantly, this also indicates that downside beta itself is not sufficient to fully explain LPT return variations. Finally, there is no evidence that the extension of higher moments into the downside beta model is essential. However, the significance of downside beta in explaining cross-sectional LPT return variations has diminished once the co-kurtosis is controlled. The possible explanation is that downside beta and co-kurtosis might capture some similar asymmetric aspects. Therefore, the inclusion of co-kurtosis will lower the explanatory power of downside beta. All of these findings provide additional insights into LPT pricing.

The important practical implication from this study is that investors and real estate analysts can employ LPM-CAPM rather than CAPM, since downside beta appears to be a more rational systematic risk measure than traditional systematic risk measures. Interestingly, the significant explanatory powers of downside beta, book-to-market ratios, and momentum effects identified in this study are related to investor behavior. Downside beta is argued to be more consistent with investors' utilities functions and behavior. Recently the importance of 'extrapolation theory' was used to explain value anomalies in U.S. REITs (Ooi, Webb, and Zhou (2007). Additionally, Chui, Titman, and Wei (2003b) have also provided support for the link between investor over-confidence and the momentum effect in U.S. REITs. Clearly, the importance of investors' behavior and 'behavior finance' theories in explaining the cross-sectional variations of LPTs warrants further research. Moreover, additional macroeconomic variables should also be considered in order to improve the models.

Endnotes

1. Recently Standard & Poor's and the Australian Stock Exchange have proposed to rename the Australian LPTs to Australian REITs, which is more globally used terminology.

2. The GICS for delisted LPTs is not available via Bloomberg and DatAnalysis. Hence, the ASX sub-code was used to identify the classification of the delisted LPTs.

References


—. Retail Stocks, Retail REITs, and Retail Real Estate. *Journal of Real Estate Research*, 1994, 9, 65–78.


The authors would like to thank participants at the 23rd American Real Estate Society Conference, San Francisco, California and 14th European Real Estate Society Conference, London, UK for their comments and feedback on an earlier draft of this paper.