MOMENTUM PROFITS IN AUSTRALIAN LISTED PROPERTY TRUSTS

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ABSTRACT

This paper examines the profitability of momentum trading strategies in Australian listed property trusts (LPTs). Monthly value-weighted momentum portfolios are formed using the monthly excess returns of LPTs for the period from 1990 to 2005. Overall the findings confirm that a momentum trading strategy in Australian LPTs is a profitable strategy. More specifically, momentum strategies are profitable after adjusting for variance and downside risk where the momentum returns substantially outperform the benchmark. An analysis using different study periods confirm the findings about momentum. The practical implication from this study is that investors can generate substantial abnormal returns by adopting a momentum trading strategy, particularly with a long strategy (i.e. winner portfolios).

Keywords: Momentum returns, risk-adjusted returns, normality, downside risk, Australian LPTs

INTRODUCTION

Momentum strategy was first proposed by Jegadeesh and Titman (1993). With reference to investing, this strategy asserts that past winners will continue to outperform losers over the short-term into subsequent periods. Hence, they suggested that investors can earn substantially abnormal returns by purchasing past winners (high performing stocks) and selling past losers (low performing stocks). Their study also provided empirical evidence for momentum profits in the US stock market over short-term horizons of between three and twelve months.

The profits of momentum strategies have been also demonstrated in other stock markets such as European and emerging markets (Rouwenhorst, 1998, 1999). Similarly in Australia, Hurn and Pavlov (2003) identified a strong medium-term momentum effect in Australian stock returns. This was confirmed by Demir et al. (2004) who found there was a greater magnitude of momentum returns from Australian equities in comparison to momentum returns from other share markets. These findings collectively confirm the presence of the momentum effect in stock returns.

Similar results have been also demonstrated in both U.S. and U.K. real estate markets in which momentum strategies are profitable on raw and risk-adjusted return bases (Chui et al., 2003b; Marcato and Key, 2005). However, these studies employed variance as a risk measure where it is bound by several strict assumptions such as (a) return distributions are normally distributed and (b) all investors dislike both extreme high and low returns. The normality assumption in return distributions has been debated and challenged by extensive empirical studies (Young and Graff, 1995; Lu and Mei 1999). Furthermore, the second assumption is not intuitively appealing. These limitations could have far-reaching implications for real estate risk management and investment strategies including momentum trading strategies.

In order to obviate these limitations, recently a growing body of finance and real estate literature emphasises the importance of downside risk. Downside risk is an asymmetric risk measure that only focuses on downside and does not require normal distribution assumption. This risk measure is intuitively appealing and in-line with a survey undertaken by Mao (1970) where investors only dislike downside likelihood, while upside likelihood is viewed as favourable upside potential. Additionally, downside risk also emerges as an appropriate risk measure in skewed return distribution by effectively accommodating the non-normality in skewed return distribution and accurately estimating the risk for skewed assets.

The aim of this study is to investigate the profitability of implementing a momentum investment strategy in Australian Listed Property Trusts (LPTs). The contributions of this study are twofold. First, an investigation on profitability of momentum strategy in Australian LPTs offers another dataset for examining the profitability of momentum trading strategy in real estate and provides a comparison with both US and UK real estate markets. Second, unlike previous studies into momentum effects, the non-normality in return distribution is taken into consideration in this research by estimating risk and adjusting return. Downside risk-adjusted technique is also employed in order to demonstrate the baseline results hold for alternative risk-adjusted technique.

This paper is structured as follows. Section two reviews the related literature, with section three containing a discussion about the data and methodology of this study. The results about momentum profits in a raw excess return and two risk-adjusted frameworks are reported and discussed in section four. Section five summarises the findings from the study.

LITERATURE REVIEW

Few researchers have emphasised the momentum effect in a real estate context. Young and Graff (1996) indirectly identified evidence that they found a strong persistence in the top and bottom quartiles of the rankings in annual returns from U.S. direct property. Marcato and Key (2005) also identified a strong momentum effect in British direct property on a risk-adjusted performance basis, although the gains were not sufficient to offset the transaction costs. Moreover, the momentum profits diminished significantly once the valuation-based indices were de-smoothed. Performance persistence was also studied by Lin and Yung (2004) who revealed a short-term persistence in U.S. real estate mutual funds. Similar results were also found in U.S. commingled real estate funds (CREFs) by Gallo et al. (2006), where CREFs exhibited persistence in performance on both an excess return and risk-adjusted return basis.

Stevenson (2002) focused on international real estate securities and documented a momentum effect on a short-term basis, in which prior winner portfolios significantly outperformed the loser and contrarian portfolios, even on a risk-adjusted return basis. Lu and Mei (1999) also found that the momentum strategies outperformed the conventional buy-and-hold strategy in six of the ten emerging real estate markets in their sample on raw return and risk-adjusted return bases. Interestingly, they also demonstrated that the momentum trading strategy performed better in volatile markets than lower volatility markets.

In the LPT or Real Estate Investment Trust (REIT) market, Graff and Young (1997) found a strong persistence in annual and monthly U.S. REIT returns; however there was no similar evidence for the quarterly returns. Chui et al. (2003b) examined the momentum effect in U.S. REIT market during 1983-1999 sample period, where the results confirmed that momentum returns in REITs are only significant in post-1990 sample period on excess return and risk-adjusted return bases. In a later study, Glascock and Hung (2005) confirmed momentum profits in U.S. REITs by utilising a longer time-series data (1972-2000). Another study by Chui et al. (2003a) which examined the relationship between momentum effect and expected return of U.S. REITs during 1984-2000 revealed similar results in momentum returns from REITs.

Most importantly, research into risk and momentum return distribution characteristics has received little attention in previous studies. Recently, there has been a large amount of evidence documenting that real estate return distributions are not necessarily normally distributed. For example, Myer and Webb (1993) found non-normal evidence for individual U.S. REITs. For direct property in the U.S., Young and Graff (1995) found that during the study period between 1980 and 1992, there was no evidence to support the normality assumption for Russell-NCREIF annual returns in any calendar year. Similar methodology was adopted by Graff et al. (1997) when examining Australian commercial real estate returns and where similar results were demonstrated for rejecting normality assumptions. Lu and Mei (1999) documented similar results for other emerging property share markets. Note that Peng (2005) also found that Australian LPTs in general are positively skewed.

If a return distribution is not normally distributed then the first two moments, namely mean and variance, are unable to fully describe the distribution. Therefore, alternative risk adjusted techniques are required in order to accurately estimate risk. One of the most common alternative risk-adjusted measures is the Sortino ratio. The advantage of the Sortino ratio is that it employs downside risk rather than variance when measuring risk.

More recently, Pedersen and Rudholm-Alfvin (2003) confirmed that the Sortino ratio is more applicable when a return distribution is not normality distributed and it can capture some of the asymmetric risk that is not captured by Sharpe ratio. Plantinga and de Groot (2001) also argued the importance of the relationship between performance measures and preference functions. They found that Sortino ratio is suitable for investors who have high and intermediate levels of risk aversion; on the other hand, the Sharpe ratio corresponds to investors with low degree of risk aversion. More importantly, Sortino and Price (1994) revealed that downside risk-adjusted performance provides different results for risk-adjusted performance in a variance framework. This is consistent with the results found by Biglova et al. (2004), Leggio and Lien (2003) and Stevenson (2001).

The primary conclusion that can be drawn from the literature is that momentum strategies are profitable on both a raw and risk-adjusted return basis in real estate. Furthermore, the downside risk-adjusted technique appears as a more sensible risk-adjusted technique than traditional risk-adjusted techniques. However, there is little attention focused on examining the profitability of momentum strategies in Australian LPTs in a downside risk framework.

DATA AND METHODOLOGY

This study utilises monthly data for all Australian LPTs listed on the Australian Stock Exchange (ASX) over the period from 1990 to 2005. Due to the limited availability of data with no reliable observations recorded before 1990, this study commences in 1990s. The study period can be further divided into sub-two periods: (a) period 1 (1990-1998) and (b) period 2 (1999-2005). The midway point was chosen as 1998 since the total number of LPTs peaked in 1999; soonafter it decreased due to the increased number of mergers and acquisitions. All LPTs are included in this study in order to avoid survivorship bias. Consistently with Chui et al. (2003b), a LPT is only included in the analysis if it has been listed for at least more than two years. LPTs were identified by using the Global Industry Classification Standard (GICS) and ASX Sub-Code. The prices and market capitalisations for all LPTs were obtained from Bloomberg and FinAnalysis. The missing data were found manually by using the publication 'Shares Magazine', which is a monthly magazine bound with ASX journal and produced by the ASX. The S&P/ASX 200 Property Trusts Index was used as a benchmark for Australian LPTs and the one month interbank rate was employed as the risk-free rate, with the data extracted from Datastream.

Momentum portfolios formation

Value-weighted momentum portfolios in this study were created with using the forming methods of Chui et al. (2003b). At the end of month (t), all LPTs in the sample were ranked in ascending order based on the past six-month returns (t-5 to t-1) with dividends. The loser portfolios (L, the LPTs in the bottom one-third) and winner portfolios (W, the top one-third) were held for either one (1) month, six (6) months or twelve (12) months.

Monthly value-weighted momentum returns were calculated by using the market capitalisation of LPT at the end of the ranking month (*t*-1) as the weight. At least 5 LPTs were required for each portfolio in any month during the sampling period.

As proven by Fisher (1966) and Lo and MacKinlay (1990), bid-ask bound error and non-synchronous trading will increase autocorrelation in stock returns. As such, the returns on these portfolios are measured one month after the ranking periods in order to reduce the non-synchronous trading and bid-ask bounce effects. The missing data during the holding period are replaced with unconditional mean returns from the sample. The portfolio is rebalanced in the month if a LPT is delisted and deleted from the database. Overlapping portfolios are constructed comprising the W(L) portfolios in the current month as well as the previous (K-1) months, where K is the holding period. The momentum portfolios are zero-cost portfolios made up of a long position in winner portfolio and a short position in loser portfolios (W-L).

Risk-adjusted performance analysis

In this study, both the Sharpe ratio and Sortino ratio were employed to assess the risk-adjusted performance relative to the momentum portfolio. Sharpe ratio is a traditional and popular ratio that measures risk in a variance framework in which includes both upside potential and downside risk. The Sharpe ratio can be computed with the following formula:

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

where R_p is the return from momentum portfolio, R_f is the risk free rate of return and σ_p is the standard deviation of momentum portfolio.

In contrast, the Sortino ratio applies to a downside risk framework in which it emphasises measuring the downside risk in an asset or a portfolio. The computation of the Sortino ratio is as follows:

$$Sortino = \frac{R_p - \tau}{DD_p} \qquad (2)$$

where R_p is the return from momentum portfolio, τ is the target return and DD_p is the downside deviation of momentum portfolio in which it is calculated as:

$$DD_\alpha\left(\tau, R_p\right) = \sqrt[\alpha]{\frac{1}{T-1}\sum_{t=1}^{T}[Max\ (0,(\tau - R_p))]^\alpha} \qquad (3)$$

where α is the degree of the Lower Partial Moment (LPM) and T is the number of returns. For consistency, the α is equal to 2 in this study. It should be noted it is also known as semi-variance. Nelling and Gyourko (1998) argued that mean reversion trading strategy involves large transaction costs and bid-ask spreads. Hence they suggested the total relevant transaction costs probably exceeded 2% per round-trip.

Recent quotes from the website of Commonwealth Securities Ltd (www.comsec.com.au) in Australia confirmed the one-way commission cost is minimum $54.60 up to $10,000 transaction value and the average price over the full sample was $1.40. In other words, the average transaction cost excluding the bid-ask spread in the sample was 1.6% per round trip. Investors normally require a return which is higher than the cost of investment and therefore 2.5% was selected as the first target rate of return. It must be noted that commission fees could have varied over the study period, although for the purpose of this study, it is assumed that the level of commission remained constant at 2.5% over the study period in line with no time series data is available. The mean of momentum return was selected as the second target rate.

The descriptive data for the Australian LPTs in the sample are presented in Table 1. Table 2 summarises the descriptive data for the naïve LPT market portfolio and the winner and loser portfolios.

Table 1: Descriptive data for LPTs over 1990-2005

Sample Period	**Full Period (1990-2005)**	**First Sub-Period (1990-1998)**	**Second Sub-Period (1999-2005)**
Count	6905	3179	3732
Mean	0.580%	0.497%	0.650%
Standard Deviations	0.026	0.024	0.028
Maximum	28.717%	24.902%	28.717%
Minimum	-14.579%	-14.579%	-13.558%

Table 2: Descriptive data for momentum portfolios

Sample Period	LPT Market	Winner Portfolio	Loser Portfolio
Full Period (1990-2005):			
Average no. of LPTs	39	12	12
(Minimum no. of LPTs)	(15)	(5)	(5)
Average Market Capitalisation	574,606,974	528,571,986	555,381,015
First Sub-Period (1990-1998):			
Average no. of LPTs	33	10	10
(Minimum no. of LPTs)	(15)	(5)	(5)
Average Market Capitalisation	308,982,344	349,429,673	305,368,565
Second Sub-Period (1999-2005):			
Average no. of LPTs	45	14	14
(Minimum no. of LPTs)	(37)	(11)	(11)
Average Market Capitalisation	867,570,330	741,435,204	852,454,632

Note: the descriptive data for winner and loser portfolios are based on 6 months past returns and 6-months holding period.

Interestingly, Table 2 reveals that the average number of LPTs was larger in the second sub-period. This can be attributed to the growth of the LPT market. Another indicator for the growth of the market is the average market capitalisation of the LPT market which has increased considerably over the sample period. The loser portfolios have a higher average market capitalisation than the winner portfolios, which is more obvious in the second sub-period.

RESULTS AND DISCUSSION

Momentum profits-raw return

The first stage of the analysis examined the momentum returns in LPTs. The results of the average excess momentum returns for the LPTs are reported in Table 3.

Table 3: Momentum returns over 1990-2005

Holding Period (k)	Portfolio	Full Period (1990-2005)	First Sub-Period (1990-1998)	Second Sub-Period (1999-2005)
	S&P/ASX 200 LPT	**0.4338% (0.051)****	**0.4340% (0.211)***	**0.4337% (0.080)****
1-Month	Winner	2.041% (0.000)***	1.923% (0.000)***	2.181% (0.000)***
	Losers	-0.979% (0.000)***	-1.23% (0.000)***	-0.682% (0.000)***
	Winners-Losers	**3.020% (0.000)*****	**3.151% (0.000)*****	**2.863% (0.000)*****
6-Months	Winner	2.025% (0.000)***	1.918% (0.000)***	2.151% (0.000)***
	Losers	-0.983% (0.000)***	-1.202% (0.000)***	-0.072% (0.000)***
	Winners-Losers	**3.008% (0.000)*****	**3.121% (0.000)*****	**2.874% (0.000)*****
12-Months	Winner	2.009% (0.000)***	1.902% (0.000)***	2.137% (0.000)***
	Losers	-0.982% (0.000)***	-1.199% (0.000)***	-0.725% (0.000)***
	Winners-Losers	**2.992% (0.000)*****	**3.101% (0.000)*****	**2.863% (0.000)*****

Note: p-value is shown in parentheses. A * indicates significance level at 10%. A ** indicates significance level at 5%. A*** indicates significance level at 1%.

Over every time period, all momentum strategies produce substantial profits with around 3% and statistically different from zero at 1%. Moreover, different holding periods do not change the results significantly. In other words, the momentum strategies in Australia LPTs are profitable over a short-term period. More importantly, momentum returns in Australian LPTs are higher than momentum returns that are identified in U.S. REITs which is consistent with the results from Demir et al. (2004) for the Australian stock market. However, the momentum profits from Australian LPTs are lower than momentum returns found by Demir et al. (2004) in the Australian stock market.

The sub-period analysis further confirms the profitability of momentum strategies in LPTs where the results confirm there is little time variation in momentum returns. During the first sub-period, the momentum strategies generate higher momentum returns than the second sub-period; while both momentum returns are statistically significant at 1%. Interestingly, the results also illustrate that long strategies (winner portfolios) can generate higher returns in comparison to short strategies in Australian LPTs. In other words, a long strategy is more profitable than a short strategy.

Another point that can be observed in Table 3 is that momentum portfolios substantially outperform the benchmark index over the entire study period. The momentum returns are almost seven times higher than the benchmark. T-test was employed in order to formally compare the momentum strategy results with the benchmark. The null hypothesis is the mean returns from momentum strategies are equal to the mean of benchmark, with the results of t-test are presented in Table 3. Clearly, the t-test confirms that the findings from Table 4 where momentum strategies surpass the benchmark at 1% significance level.

Table 4: Comparison between momentum strategies and the benchmark

Holding Period (k)	**Portfolio**	**Full Period (1990-2005)**	**First Sub-Period (1990-1998)**	**Second Sub-Period (1999-2005)**
1-Month	Winners-Losers	-10.989***	-8.511***	-7.373***
6-Months	Winners-Losers	-11.190***	-8.562***	-7.846***
12-Months	Winners-Losers	-11.306***	-8.670***	-7.985***

A * indicates significance level at 10%. A ** indicates significance level at 5%. A*** indicates significance level at 1%.

In short, in a similar manner to U.S. REITs, momentum profits in raw excess returns are prevalent in Australian LPTs. More specifically, the profits from momentum strategies in LPTs are considerably higher than the benchmark.

Normality tests

With reference to normality, there are several concerns that should be addressed. It has been accepted in extensive studies that real estate return distributions are not necessarily normally distributed. However, little research has been conducted in regards to LPT momentum return distributions, with histogram and normality plots for the benchmark and momentum return series displayed in Appendix 1. Overall, these histograms confirm that every momentum return series does not follow the theoretical normal curve. In contrast, the benchmark returns series are almost always following the normal curve. Therefore, the normality assumption could be invalid for the momentum return series.

Three normality tests, namely Jarque-Bera (JB) test, Lillifors (L) test and Shapiro-Wilk (SW) test, as well as skewness and kurtosis are provided in order to formally quantify the normality of these series. The results are reported in Table 5.

Table 5: Normality tests for the momentum returns

Holding Period (k)	Portfolio	Skewness	Kurtosis	JB test	SW test	L Test
Panel A: Full Period (1990-2005)						
	S&P/ASX 200 LPT	0.143	0.370	54.240***	0.990	0.053
1-Month	Winners-Losers	0.810	0.564	66.328***	0.947***	0.090***
6-Months	Winners-Losers	0.473	-0.776	117.437***	0.952***	0.101***
12-Months	Winners-Losers	0.353	-0.948	124.660***	0.952***	0.114***
Panel B: First Sub-Period (1990-1998)						
	S&P/ASX 200 LPT	0.274	-0.070	33.321***	0.984	0.078*
1-Month	Winners-Losers	0.452	-0.997	70.671***	0.943***	0.103***
6-Months	Winners-Losers	0.375	-1.049	71.360***	0.941***	0.120***
12-Months	Winners-Losers	0.111	-1.215	74.974***	0.944***	0.139***
Panel C: Second Sub-Period (1999-2005)						
	S&P/ASX 200 LPT	-0.377	0.631	28.603***	0.992	0.042
1-Month	Winners-Losers	1.320	3.128	24.742***	0.907***	0.125***
6-Months	Winners-Losers	0.578	-0.376	45.099***	0.930***	0.128***
12-Months	Winners-Losers	0.631	-0.254	43.142***	0.915***	0.158***

Note: JB test is Jarque-Bera Test. SW is Shapiro-Wilk Test. L test is Lilliefors Test. A * indicates significance level at 10%. A ** indicates significance level at 5%. A*** indicates significance level at 1%.

The skewness statistics confirm the findings from the graphs presented in Appendix 1, in which almost all return distributions are positively skewed, except the benchmark in second sub-period. These results indicate the return distributions have lower downside variability in comparison to upside variability. More importantly, the measure of variance may be used to overestimate the risk for the portfolios. On the other hand, momentum return distributions over different holding periods display negative kurtosis over the full sample period, except for the momentum returns over a one month holding period. However, the benchmark reveals a moderate positive kurtosis. For the first sub-sample, all distributions reveal negative kurtosis, while only 6 month and 12 month momentum returns displayed negative kurtosis in the second sub-sample.

Several important observations can be drawn from the three normality tests of this return series. First, both momentum return and benchmark return distributions do not follow the theoretical normal distribution over the whole sample period. The normality assumptions of the momentum return distribution were be rejected by the JB test, SW test and L test with statistically significance at 1%. However, similar results for the benchmark were not found using SW test and L test. Second, the first and the second sub-sample periods revealed similar results for momentum return and benchmark return distributions, except for the L test where it rejected the normality distribution assumption for the benchmark return distribution at 10% in the first sub-sample period. The non-normality in momentum LPTs returns supported findings from previous studies into LPT returns.

In summary, the distributions of these returns were not necessarily normally distributed. Important implications and insights drawn from the analysis is that the non-parametric tests should be conducted for cross-checking purposes where the normality assumption is not required by these tests. Another caveat, being the appropriateness of using variance as risk measure, is questionable. Therefore, downside risk should be given full consideration when estimating risk in line with its theoretical superiority.

Non-parametric tests

Three non-parametric tests were conducted in order to undertake a comparison between momentum strategies and the benchmark after allowing for non-normality. The first test was the sign test where it is hypothesised that the number of signs (X) in which momentum returns outperforming the benchmark more than 50% of time. $H_0 : X > 0.5$, while $H_1 : X < 0.5$.

Second, the Wilcoxon Signed Rank test was employed in which the null hypothesis is the median difference between momentum strategies and the benchmark is zero. Third, the Mann-Whitney test was conducted where it is hypothesised that the median of momentum strategies are equal to the median of benchmark. The results from these tests are presented in Table 6.

Table 6: Non-parametric tests for the comparison between momentum strategies and the benchmark

Holding Period (k)	Portfolio	Full Period (1990-2005)	First Sub-Period (1990-1998)	Second Sub-Period (1999-2005)
Panel A: Percentage of Outperformed Index (%)				
1-Month	Winners-Losers	0.801	0.802	0.812
6-Months	Winners-Losers	0.817	0.792	0.859
12-Months	Winners-Losers	0.817	0.812	0.835
Panel B: Sign Test				
1-Month	Winners-Losers	8.139***	5.771***	5.640***
6-Months	Winners-Losers	8.579***	5.572***	6.508***
12-Months	Winners-Losers	8.579***	5.970***	6.074***
Panel C: Wilcoxon Signed Ranks Test				
1-Month	Winners-Losers	-8.818***	-6.734***	-5.863***
6-Months	Winners-Losers	-8.927***	-6.745***	-6.006***
12-Months	Winners-Losers	-8.998***	-6.805***	-6.083***
Panel D: Mann-Whitney Test				
1-Month	Winners-Losers	-10.366***	-7.890***	-6.593***
6-Months	Winners-Losers	-10.477***	-7.936***	-6.706***
12-Months	Winners-Losers	-10.497***	-7.920***	-6.659***

A * indicates significance level at 10%. A ** indicates significance level at 5%. A*** indicates significance level at 1%.

Panel A depicts that momentum strategies outperformed the index at least 80% of the time, where two different sub-sample periods do not change the results markedly. In other words, these results provided indirect evidence to support momentum strategies in which the strategies produce returns that higher than the benchmark in 80% of occasions over all time periods. This was formally confirmed in Panel B, where the results indicated that all momentum strategies surpassed the benchmark considerably more than half of the time and was statistically significant at 1%. Similar significant results were revealed in Panels C and D in which both the Wilcoxon Signed Rank test and the Mann-Whitney test confirmed the returns from momentum strategies are not equal to returns from the benchmark at a 1% level of significance. This is strong evidence that the momentum strategies outperformed the benchmark considerably.

These non-parametric tests results are encouraging and provide further support for the use of momentum strategies in Australian LPTs. Simply explained, these results confirmed that momentum strategies outperformed the benchmark considerably on a raw excess return basis.

Risk measures

Another issue of concern is the amount of compensation for risk. Although higher momentum returns could be compensation for a higher level of risk, this has been rejected in many studies into U.S. real estate market. As a consequence, an examination of the risk in the momentum strategies is crucial. Table 7 reports the riskiness of the momentum portfolio and benchmark index in variance and downside risk frameworks.

Table 7: Risk of momentum portfolios and the benchmark over 1990-2005

Holding Period (k)	Portfolio	Full Period (1990-2005)	First Sub-Period (1990-1998)	Second Sub-Period (1999-2005)
Panel A: Standard Deviation				
	S&P/ASX 200 LPT	3.013%	3.452%	2.161%
1-Month	Winners-Losers	0.897%	0.848%	0.952%
6-Months	Winners-Losers	0.714%	0.697%	0.716%
12-Months	Winners-Losers	0.603%	0.596%	0.567%
Panel B: Downside Deviation ($\tau = 2.5\%$)				
	S&P/ASX 200 LPT	3.428%	3.697%	3.079%
1-Month	Winners-Losers	0.254%	0.186%	0.316%
6-Months	Winners-Losers	0.171%	0.116%	0.220%
12-Months	Winners-Losers	0.120%	0.093%	0.145%
Panel C: Downside Deviation ($\tau = Mean$)				
	S&P/ASX 200 LPT	3.801%	4.072%	3.468%
1-Month	Winners-Losers	0.545%	0.472%	0.624%
6-Months	Winners-Losers	0.461%	0.411%	0.513%
12-Months	Winners-Losers	0.411%	0.380%	0.445%

Clearly, both risk measures confirmed the benchmark index has a higher risk than the momentum portfolios. Consistent with the results from Sing and Ong (2000) and Bond and Satchell (2002), Table 7 also exhibits that the standard deviations for all return series are substantially higher than the semi-deviation, except the benchmark.

Another interesting pattern that emerges in Table 7 is that both the standard deviation and downside deviation indicates that momentum profits in the second sub-period are riskier than in the first sub-period. The only exception is where the 12-month holding period presents divergence results on a standard deviation basis. Conversely, the index shows that the first sub-period is riskier than the second sub-periods. The important finding from the results is that the riskiness of an asset changes with different risk measures. As such, investors and portfolio managers should use extreme caution when selecting the most appropriate risk measures in line with their investment objectives and risk tolerance level.

Risk-adjusted performance

The momentum returns on the risk-adjusted performance basis are listed in Table 8. The risk-adjusted performance relative to the portfolios was first measured by the Sharpe ratio and then by the Sortino ratio.

Table 8: Risk-adjusted Momentum Returns over 1990-2005

Holding Period (k)	Portfolio	Full Period (1990-2005)	First Sub-Period (1990-1998)	Second Sub-Period (1999-2005)
Panel A: Sharpe Ratio				
	S&P/ASX 200 LPT	-0.027	-0.041	-0.003
1-Month	Winners-Losers	2.794	3.037	2.546
6-Months	Winners-Losers	3.491	3.652	3.399
12-Months	Winners-Losers	4.112	4.233	4.275
Panel B: Sortino Ratio ($\tau = 2.5\%$)				
	S&P/ASX 200 LPT	-0.603	-0.559	-0.671
1-Month	Winners-Losers	2.047	3.497	1.149
6-Months	Winners-Losers	2.963	5.371	1.699
12-Months	Winners-Losers	4.102	6.437	2.497
Panel C: Sortino Ratio ($\tau = Mean$)				
	S&P/ASX 200 LPT	-0.676	-0.632	-0.742
1-Month	Winners-Losers	0.023	0.304	-0.233
6-Months	Winners-Losers	0.000	0.275	-0.261
12-Months	Winners-Losers	-0.039	0.244	-0.326

The portfolios' performances were improved on the risk-adjusted basis. After adjusting for variance, the momentum Sharpe ratios were significantly higher than the benchmark. The first sub-period exhibited higher risk-adjusted returns than in the second sub-period for both ratios over different holding periods except the 12-month holding period. However, all momentum portfolios noticeably outperformed the benchmark on a variance risk-adjusted basis.

Downside risk-adjusted returns with either $\tau = 2.5\%$ or $\tau = Mean$ provided similar results in which the strong LPT downside risk-adjusted momentum returns were clearly evident across all timeframes, while the magnitude declined substantially for Sortino ratios with $\tau = Mean$. Interestingly, the Sortino ratios with $\tau = Mean$ in the second sub-period report negative results for all momentum strategies, while all of these momentum strategies still surpass the benchmark in the second sub-period.

Another observation is that the Sharpe ratios for momentum portfolios over different holding periods were substantially lower than for the Sortino ratios. This can be attributed to the different risk measures employed for both ratios and the non-normality of the return distributions. Nevertheless, both ratios offered similar results and confirmed that momentum portfolios are profitable. This is dissimilar to the results from previous downside risk studies, where downside risk provided divergence results in performance measurement. One possible explanation would be the relatively small Sharpe ratios. Lien (2002) showed analytical evidence that the Sortino ratio will provide an opposite ranking to Sharpe ratio if only the Sharpe ratio is large enough. Another explanation is the significant positive skewness in momentum return distributions as listed in Table 5. The positive skewness reduces downside likelihood and results in higher downside-risk adjusted momentum returns. However, there was no similar significant positive skewness evident in the benchmark. Therefore, it is reasonable to expect that downside-risk adjusted returns confirm that momentum returns outperformed the benchmark.

These results confirmed the findings in the previous section and provided further evidence that momentum returns are profitable, both on an excess return and risk-adjusted return basis. Moreover, sub-sample analysis results indicated that momentum returns are more profitable in the first sub-period than in the second sub-period.

Comparison based on risk-adjusted returns

In order to formally compare the strategy results with the benchmark, the Jobson and Korkie (1981) pairwise test was employed. The null hypothesis for the Jobson and Korkie test is that no difference between the ratios of momentum portfolios and the ratio of benchmarks. The Jabson and Korkie test statistic is computed as follows:

$$Z_i = \sigma_m \bar{R}_i - \sigma_i \bar{R}_m / \sqrt{\theta} \quad (4)$$

where

$$\theta = \frac{1}{T}\left\{2\sigma_i^2\sigma_m^2 - 2\sigma_i\sigma_m\sigma_{i,m} + \frac{1}{2}\overline{R}_i^2\sigma_m^2 + \frac{1}{2}\overline{R}_m^2\sigma_i^2 - \frac{\overline{R}_i\overline{R}_m}{2\sigma_i\sigma_m}\left(\sigma_{i,m}^2 + \sigma_i^2\sigma_m^2\right)\right\} \quad (5)$$

where $\overline{R}_m$ is the mean risk premium for the benchmark index, $\overline{R}_i$ is the mean risk premium for the portfolio i, σ_m is the standard deviation of returns for the benchmark index, σ_i is the standard deviation for the portfolio i, $\sigma_{i,m}$ is the covariance of returns between portfolio i and the benchmark index, T is total number of observations.

Table 9: Comparison risk-adjusted momentum performance with the benchmark[a]

Holding Period (k)	Portfolio	Full Period (1990-2005)	First Sub-Period (1990-1998)	Second Sub-Period (1999-2005)
Panel A: Sharpe Ratio				
1-Month	Winners-Losers	15.591***	11.871***	10.094***
6-Months	Winners-Losers	16.701***	12.507***	11.118***
12-Months	Winners-Losers	17.378***	12.901***	11.730***
Panel B: Sortino Ratio ($\tau = 2.5\%$)				
1-Month	Winners-Losers	16.234***	13.399***	9.091***
6-Months	Winners-Losers	17.781***	14.027***	10.490***
12-Months	Winners-Losers	18.662***	14.146***	11.708***
Panel C: Sortino Ratio ($\tau = Mean$)				
1-Month	Winners-Losers	6.154***	6.005***	3.274***
6-Months	Winners-Losers	6.020***	5.899***	3.089***
12-Months	Winners-Losers	5.781***	5.841***	2.682***

[a] Note: The equality of performance tests with the details of Jobson and Korkie (1981). The tests are based on a variance framework. A * indicates significance level at 10%. A ** indicates significance level at 5%. A*** indicates significance level at 1%.

Results from the Jabson and Korkie (1981) tests are reported in Table 9. As expected, there were significant differences in the Sharpe ratios between momentum portfolios and the benchmark index. In other words, the momentum portfolios markedly outperformed the index at a 1% level of significance. Similar results were obtained from the Sortino ratio which employed downside risk as the risk measure, with either $\tau = 2.5\%$ or $\tau = Mean$. These results would appear to indicate, as previously discussed in Table 3 and Table 8, that the momentum investment strategies are profitable on excess return and risk-adjusted return bases in both risk frameworks.

Robustness checks

To reinforce the previous findings of this study, the baseline results were further examined by controlling for the size of LPTs. The aim was to investigate whether size drives the abnormally high profits or momentum strategy itself. First, at the end of each month, all LPTs in the sample were equally sorted by weighting into three groups based on their size. These three groups were classified as small, medium and large groups with Table 10 presenting the results.

Table 10: Momentum profits to xize-sorted portfolios

Size	**Full Period (1990-2005)**	**First Sub-Period (1990-1998)**	**Second Sub-Period (1999-2005)**
Panel A: 1-Month			
Large	1.421%	1.572%	1.241%
	(0.000)***	(0.000)***	(0.000)***
Medium	0.956%	1.204%	0.663%
	(0.000)***	(0.000)***	(0.000)***
Small	2.113%	2.039%	2.220%
	(0.000)***	(0.000)***	(0.000)***
Panel B: 6-Months			
Large	1.417%	1.572%	1.233%
	(0.000)***	(0.000)***	(0.000)***
Medium	0.953%	1.125%	0.749%
	(0.000)***	(0.000)***	(0.000)***
Small	2.105%	2.004%	2.223%
	(0.000)***	(0.000)***	(0.000)***
Panel C: 12-Months			
Large	1.404%	1.592%	1.181%
	(0.000)***	(0.000)***	(0.000)***
Medium	0.968%	1.074%	0.842%
	(0.000)***	(0.000)***	(0.000)***
Small	2.109%	1.978%	2.227%
	(0.000)***	(0.000)***	(0.000)***

Note: p-value is shown in parentheses. A * indicates significance level at 10%. A ** indicates significance level at 5%. A*** indicates significance level at 1%.

The results in Table 10 reveal that momentum returns for all strategies were positive and statistically significant at 1%. However, these profits were smaller than those obtained from the raw returns. These are consistent with the previous studies. For example, Chui et al. (2003a, 2003b) found that size is not related to momentum returns and momentum strategies yielded substantial returns even after adjusting for firm characteristics. Similar results were found by Demir et al. (2004) for the Australian stock market. Consequently, this confirmed that momentum profits in Australian LPTs are robust and there was no evidence to show momentum effects will disappear after controlling for size.

CONCLUSION

This paper examined the profitability of momentum strategies in Australian LPTs by considering the normality of return distributions. Findings from the analysis confirmed that large momentum returns emerge when LPTs are grouped based on their past returns. Specifically, these momentum returns were largely generated by a long strategy (winner portfolio) and the results displayed similar patterns for different time horizons. These results are consistent with previous studies for momentum in U.S. REITs, while the momentum returns were higher than U.S. REITs. Even after non-normality in momentum return series were evident and taken into consideration by employing a downside risk-adjusted technique, momentum returns from LPTs were consistently significant higher than the benchmark.

An important implication from these findings is that momentum investment strategy is a useful trading rule for short-term investment in LPTs. Based on the monthly momentum results, investors can earn substantial momentum returns, particularly with a long strategy from LPTs. More importantly, this paper provides indirect support for the rationale of including a momentum variable in the real estate asset pricing model. However, there is an important consideration with a short position as it involves short selling activities by selling a particular stock or LPT that is not yet owned with the expectation buying back at lower price. This strategy could be difficult to implement in relation to illiquid LPTs. This limitation must be borne in mind when interpreting the results of this research.

Possible extensions of this work could be to investigate the sources of the momentum, which still remains a controversial subject in the finance literature. The analysis could also be extended by taking into consideration transaction costs and taxes on momentum returns. Nelling and Gyourko (1998) argued that the high transaction cost issue undermines the use of contrarian strategies. Additionally, Marcato and Key (2005) found similar evidence for momentum strategies in direct property, which normally involve high transaction costs.

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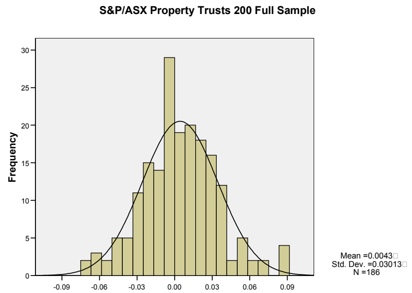
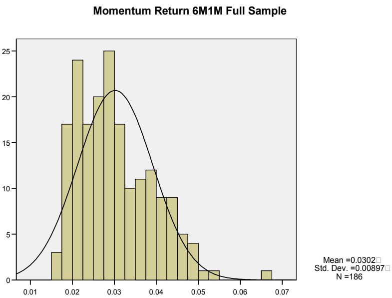
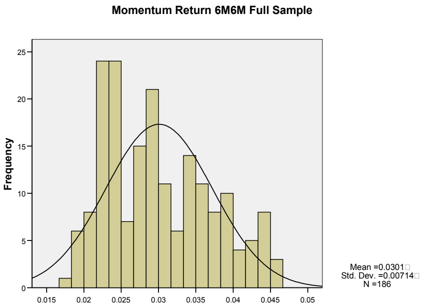
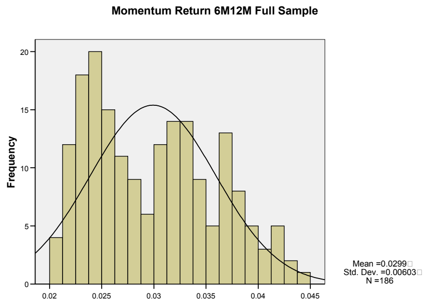
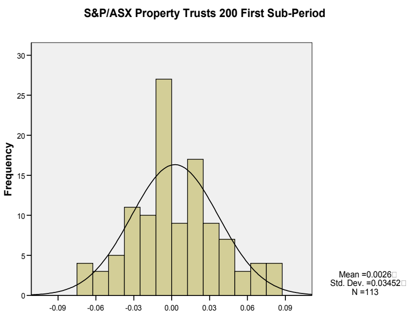
Appendix 1: Histograms and Normality Plots of All Return Distributions

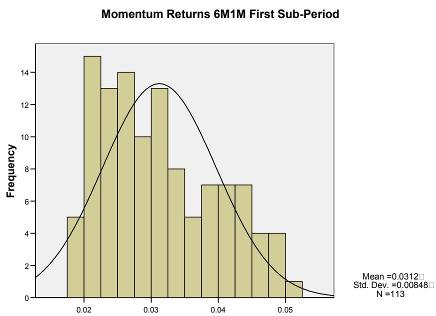


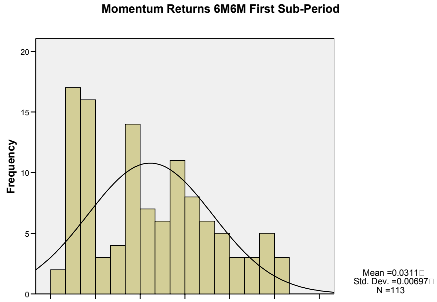








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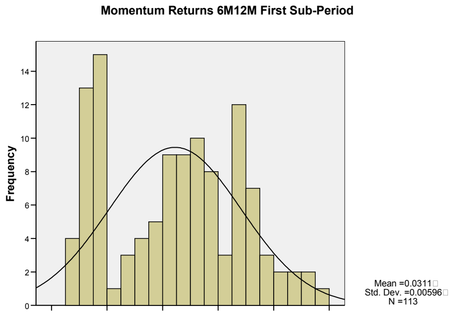
Frequency
Mean =0.0311
Std. Dev. =0.00697
N =113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Frequency
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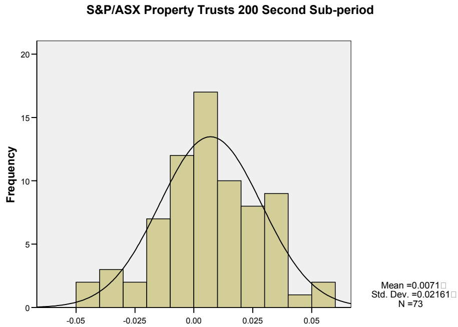
Std. Dev. =0.00596
N =113


S&P/ASX Property Trusts 200 Second Sub-period
Frequency
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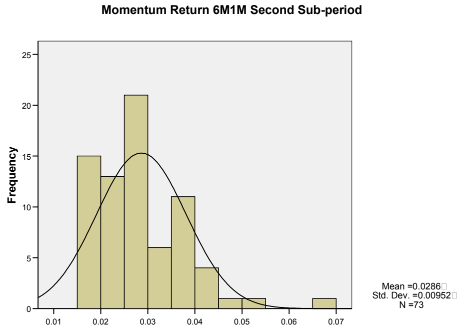
Std. Dev. =0.02161
N =73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Frequency
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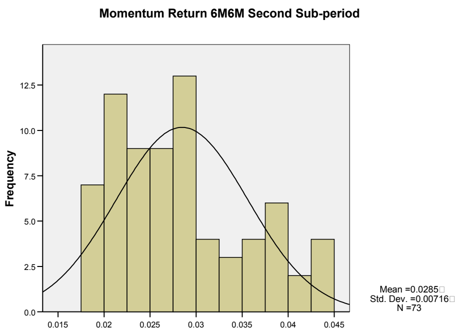
N =73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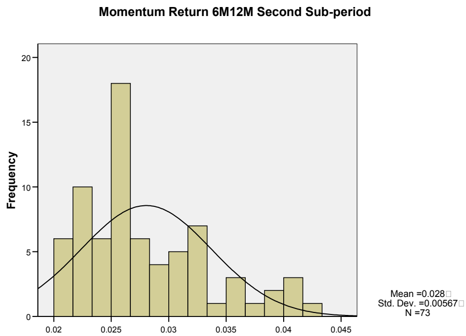
N =73


Momentum Return 6M12M Second Sub-period
Frequency
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Std. Dev. =0.00567
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