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Disentangling Size from Momentum in Australian Stock Returns

by
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Abstract:

Prior evidence concerning momentum in Australian equity returns has produced inconsistent results. This study examines the interaction between momentum and firm size. Specifically, we report that momentum returns are significant only for larger portfolios, and that this finding explains the inconsistent results of prior research. We demonstrate that momentum is present only in the top 500 stocks, and is most economically significant among the mid-cap stocks, which we call a relative size effect. However, the momentum returns are primarily generated from poor performance of the loser portfolio rather than any superior performance of the winner portfolio. In a more formal examination of the impact of size, we find significant exposure to a size factor among the combinations of size and performance portfolios. The strongest exposure to the size factor is found in small loser portfolios which also have the strongest exposure to market risk. In explaining the source of momentum returns, our findings cast doubt on the practical implementation of a trading strategy, and we suggest that successful momentum trading strategies are likely to realize 'paper' profits rather than generate real investment returns.

Keywords:

MOMENTUM; SIZE EFFECT.

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1. Introduction

Over the last two decades a number of papers have documented that past performance is related to future returns, thereby drawing into question a fundamental view of market efficiency. One strand of this literature centres on evidence that portfolios formed on the basis of past returns continue to earn returns in the same direction post-formation. Hence, a trading strategy that takes a long position in the winner portfolio financed through a short position in the loser portfolio appears to earn excess returns. The success of such a strategy is driven by the momentum in returns of the winner and loser portfolios.

Jegadeesh and Titman (1993) were among the first to document that over medium-term horizons, securities with high returns over the past three to twelve months continue to outperform securities with low returns over the same period. The literature has expanded to demonstrate that momentum exists in industry based portfolios (Moskowitz & Grinblatt 1999), and that the effect is not specific to sample periods but rather has been present and profitable since the 1920s (Grundy & Martin 2001). Further, risk does not appear to be an explanatory factor of the effect as momentum remains unexplained by the Fama and French three-factor model (Chan, Jegadeesh & Lakonishok 1996; Fama & French 1996). In summary, this growing body of evidence suggests that momentum is a pervasive feature of the US equity market.

However, evidence of momentum outside of the US market has been inconsistent. While Rouwenhorst (1998) finds evidence of momentum in twelve European countries, other studies that employ data from the Asia-Pacific markets find little evidence of profitable momentum strategies (Rouwenhorst 1999; Hameed & Kusnadi 2002).

Several papers have explored momentum in the Australian market and the results have also been inconsistent. For instance, Hurn and Pavlov (2003) document a strong momentum effect while Durand, Limkriangkrai and Smith (2006) find no supportive evidence. The Australian-based studies generally use a relatively short sample period and vary considerably in their coverage of stocks.

In this study, we re-examine the momentum effect in Australia. The paper makes three contributions. First, we utilize a long sample period spanning 26 years and provide comprehensive coverage of stocks in cross-section. Such a research design corresponds more closely with the original Jegadeesh and Titman (1993) method and thus provides for a better international comparison. In so doing, we are able to resolve the debate about whether momentum exists in Australia. Second, we explore the interaction between momentum and size. Given the well-known regularities with respect to size, and the prior belief that loser stocks by definition are likely to be small, we believe that momentum cannot be separately considered from size. To our knowledge, no previous study has undertaken a detailed examination of the interaction between size and momentum in Australia. Our findings are able to isolate where the size-momentum interaction has the greatest impact on returns. Finally, we also examine risk-adjustments and the evidence provides insight into the exposures of various size-momentum portfolios. In summary, our analysis identifies the source of apparent momentum returns and provides an explanation for previously documented results.

Any interaction with firm size is important due to the practical implications of implementing a trading strategy. In Australia, large traders and mutual funds tend

to trade within the top 300 stocks at most. Restrictions on short selling, illiquidity concerns and information asymmetry all serve to restrict the attractiveness of smaller stocks. Hence, any findings of apparent profitable momentum trading strategies need to be tempered with the reality of market imperfections. For these reasons, we argue that momentum needs to be considered within the context of size.

The paper is structured as follows. The next section outlines previous research and explores possible reasons for the inconsistency in prior findings. Section 3 then discusses the data and method. Section 4 presents the initial results for the momentum portfolios and provides evidence of the impact of size on momentum. Section 5 then presents a time-series analysis wherein the role of risk is explored, while the final section concludes.

2. Prior Evidence of Momentum

Gaunt and Gray (2003) examine monthly returns on Australian equities drawn from the AGSM-CRIF price-relative file over 1974–1998. While their study is concerned with autocorrelations in returns, there is indirect evidence that supports a positive momentum effect. Using a strategy based on one-month prior returns, Gaunt and Gray find that the winner decile portfolio out-performs the loser decile portfolio by around 6% over a one-month holding period. The finding is demonstrated to be robust to alternate risk adjustments. However, in sub-sample analysis, Gaunt and Gray find no evidence of a momentum effect among the top 200 stocks, but strong evidence of an effect outside the top 200 stocks, which prima facie points to momentum being driven by smaller firms.

Using a method more aligned to the original Jegadeesh and Titman (1993) approach, Hurn and Pavlov (2003) report evidence in support of a momentum effect in Australia. Their study uses monthly data on the top 200 securities drawn from the AGSM-CRIF price-relative database ranked by size. The study period spans 1974–1998. Hurn and Pavlov report evidence of significant positive returns over various holding periods using a sort which splits the sample into three portfolios. The strongest result is obtained for the one-year holding period wherein the momentum (winner minus loser) portfolio earns a return of around 5–7%. Over the six-month holding period, returns to the momentum portfolio are around 2–3%. Interestingly, Hurn and Pavlov split their sample into the largest 50 stocks and stocks ranked 51–200 by size and find a stronger effect in the larger stocks. That is, their findings lie in contrast to those of Gaunt and Gray (2003) albeit derived from a different method.

Demir, Muthuswamy and Walter (2004) investigate momentum strategies over 30, 60, 90 and 180-day horizons over the period 1990–2001 using decile formation. Their sample firms comprise stocks approved for short selling over the first half of the sample (up to 462 stocks) and expand the sample over the latter half of the period to include stocks listed in the All Ordinaries Index. The main contribution of Demir, Muthuswamy and Walter is to utilize daily data. Their results indicate momentum profits are observed with the best strategy earning a monthly return of 5.34% while the worst strategy earns 1.38% per month. These findings exceed the more common result found in the USA of around 1% per month, although their sample period overlaps with a sustained bull market. Demir,

Muthuswamy and Walter also examine the robustness of their results to size by forming size-neutral quartiles. The positive momentum returns are robust to size, although a general pattern emerges whereby the strongest results are associated with the smallest portfolios, in contrast to the findings of Hurn and Pavlov (2003).

Marshall and Cahan (2005) adopt a similar sample to Demir, Muthuswamy and Walter (2004) and employ data requirements that effectively restrict the sample of firms to those approved for short selling. The sample period spans 1990 to 2003, and hence overlaps closely with Demir, Muthuswamy and Walter, Marshall and Cahan (2005) employ monthly data and find some evidence of positive momentum returns with an average monthly return of 0.5%. Their momentum portfolio comprises the extreme 30% of stocks. Marshall and Cahan also examine the robustness of their findings to size and find that positive momentum is strongest among the smallest quartile of stocks. Indeed, for the largest quartile under some strategies, the effect disappears completely.

More recently, Durand, Limkriangkrai and Smith (2006) examine momentum in Australia using a research design that is the closest in construction to the original Jegadeesh and Titman (1993) approach. Compared to previous Australian studies, Durand, Limkriangkrai and Smith use a broader range of stocks by including all listed stocks. Further, Durand, Limkriangkrai and Smith use a relatively long sample period spanning 22 years from 1980 to 2001. Using decile portfolios, Durand, Limkriangkrai and Smith find no evidence of momentum and indeed find some evidence of return reversals in that the loser portfolio out-performs the winner portfolio over three-month and twelve-month periods. Of note, the Durand, Limkriangkrai and Smith study employs monthly data, but also provide a replication of the Demir, Muthuswamy and Walter (2004) study by examining daily returns over 1990–2001 and confirm the presence of a significant positive momentum effect. However, in extending their daily analysis to cover the period 1980–2001, Durand, Limkriangkrai and Smith find no evidence of a momentum effect. Hence, Durand, Limkriangkrai and Smith implicitly conclude that momentum in Australia is time-period specific. However, this finding still remains at odds with the results of Hurn and Pavlov (2003) who examine the period 1974 to 1998.

From the above, it is difficult to draw definitive conclusions. What is in no doubt is the inconsistent evidence of momentum in Australia. Different empirical designs, different sample periods and different populations of stocks are inevitably at least partly attributable to the varying results. Nonetheless, two critical issues emerge. First, any study of momentum in Australia needs to use a long time-series. The discrepancies in prior research require a time-series that covers all previously studied sample periods. It is simplistic to argue that different time periods give rise to such varying results. Second, and perhaps more important, any study needs to be careful in the selection of the sample of stocks. The evidence appears to indicate that a broader sample of stocks is associated with a reduced momentum effect. However, this finding sits paradoxically against those studies that have examined the interaction between momentum and size, as these studies document that the momentum effect is strongest among smaller portfolios. Thus, by using the broadest possible sample of stocks and also controlling for size, our study attempts to reconcile the conflicting results of these prior studies.

3. Data and Method

The data employed in this study originate from the Australian Graduate School of Management Centre for Research in Finance (AGSM-CRIF) database and cover the period 1979 to 2005. This sample period is significantly longer than previous Australian studies. The AGSM-CRIF database contains monthly prices, dividends, adjustments for capitalisation changes and returns for all Australian Stock Exchange (ASX) listed securities.

The method used to construct the momentum portfolios follows Jegadeesh and Titman (1993). To be included in the sample, a security must have traded *J*-months ago, survived during the *J*-months formation period and had traded in the month of portfolio formation. We select two periods over which *J* is defined. The analysis is conducted for six-month and twelve-month formation periods. However, we only report the results for the six-month period as the results for the twelve-month period are quite similar.[1] After applying the selection criteria, on average there are 986 stocks per year available for inclusion on the six-month momentum portfolios. This number compares with 675 stocks per year in the Durand, Limkriangkrai and Smith (2006) study, and 200 stocks in the Hurn and Pavlov (2003) study.

Consistent with prior work, the months of June and December are selected as the formation months. At the end of each formation period, the previous six-month continuously compounded return is calculated.[2] Returns are adjusted for capitalization changes and include dividends. If the stock did not trade during the month of 0 or –6 (i.e. June and December) then it is dropped from the sample.

Stocks are then ranked on the basis of their prior return and assigned to decile portfolios. The first portfolio (winner) comprises the top performing 10% of stocks whereas portfolio 10 comprises the bottom performing 10% of stocks (loser). The ten portfolios are then held for the next six months and a portfolio return is calculated using equal and value weights. At the end of the holding period the portfolios are reformed and the process is repeated thereby forming a series of rolling windows across the sample period. Note that each formation period contains no overlap with the previous formation period.

Previous studies that have examined momentum generally report portfolio returns using only equal-weighted returns, with the exception of Demir, Muthuswamy and Walter (2003) who note in unreported results that smaller stocks yield higher momentum returns than larger stocks under value-weighting. As our coverage of stocks is considerably larger than previous studies, we are concerned that an equal-weighted portfolio return may bias toward smaller firms. Indeed, the prior evidence is suggestive that momentum is more present in smaller stocks. Thus, we calculate portfolio returns using both equal-weighted and value-weighted methods.

Table 1 presents the mean and median market capitalisation of each of the ten ranked portfolios. A number of features emerge from table 1. First, the mean (median) market capitalisation of the loser portfolio is $35 million ($17 million), which is substantially smaller than any of the other nine portfolios. The next

1. The results for the twelve-month formation period are available from the authors on request.
2. We also examine a similar strategy that skips a month between portfolio formation and the holding period and the results are similar. That is, the portfolio returns are measured over months 1-7 post-formation.

smallest portfolio, which is portfolio 9, has a mean market capitalisation three times larger at $105 million (median of $39 million). Second, the average market capitalisation of the winner portfolio ($228 million) is approximately six times larger than that of the loser portfolio. However, while the winner portfolio contains considerably larger stocks than the loser portfolio, its mean (and median) market capitalisation is still lower than the market as a whole. For instance, the largest average size is found in portfolio 4, and generally portfolios 2–6 look fairly similar in average size. Considered in aggregate, this evidence tends to suggest that size is related to momentum.

Table 1

Market Capitalisation Statistics of the Performance-Ranked Portfolios

The table presents the time-series average market capitalisation of each portfolio at the time of formation. Ten portfolios are formed based on the rank of the last six-month return over the period 1979 to 2005.

Portfolio	Mean market capitalization ($ millions)	Median market capitalisation ($ millions)
Winner	227.60	124.45
2	460.58	276.81
3	507.36	315.14
4	539.25	342.05
5	490.85	306.91
6	420.92	376.74
7	294.38	194.49
8	207.57	111.73
9	104.96	39.27
Loser	34.81	16.50

Of note, the inclusion of a wider set of stocks in our study results in a far greater spread of firm size than that previously examined. For instance, the smallest stock that is included in the sample of Demir, Muthuswamy and Walter (2004) is $130 million (see footnote 6 p. 145). If this criterion was placed on our sample then over half of the winner portfolio, and the majority of portfolios 9 and 10 (loser), would be excluded from analysis. However, we note that our sample criteria allows a greater number of small stocks to enter the portfolio by definition.

The evidence that momentum appears related to size is not new. Previous studies on momentum in the USA and Europe generally find that the loser and winner portfolios contain a higher proportion of small companies compared to other portfolios.[3] As noted above, both Demir, Muthuswamy and Walter (2004) and Marshall and Cahan (2005) document evidence consistent with momentum being stronger among smaller stocks in Australia. Moreover, the result that the loser portfolio contains a higher proportion of smaller stocks is logical because

3. See Jegadeesh & Titman (1993) for evidence from the US market and Rouwenhorst (1998) for European evidence.

these stocks have experienced a substantially poor return by definition, and thus, they will have declined in value compared to other stocks in the market.

To further examine the interaction of momentum and size, we form 25 portfolios based on size and momentum. This is accomplished by ranking all stocks first by market capitalisation, at the end of each formation period (i.e. June and December), and assigning each stock to one of five size-based portfolios, where each portfolio contains an equal number of stocks. Independently, all stocks are ranked by their prior six-month return and assigned to one of five momentum portfolios, where each portfolio contains an equal number of securities. Thus, at the end of each formation period, every stock belongs to one of five size portfolios and one of five momentum portfolios. This leads to the creation of 25 size-momentum portfolios.

Panel A of table 2 reports the average number of securities within each size-momentum portfolio. It clearly shows that there are a significantly smaller proportion of loser stocks in the two largest size portfolios compared to the other portfolios within each size quintile. In contrast, the two smallest size portfolios have a significantly larger proportion of loser stocks. Given the evidence that the mean market capitalisation of the loser portfolio is significantly smaller than the other portfolios (from table 1), the result that a higher proportion of past losers enter the two smallest size quintiles is unsurprising. In contrast the winner portfolio has a more even spread of stocks throughout the five size quintiles.

Panels B and C of table 2 report the mean and median market capitalisation of each of the 25 size-momentum portfolios. Overall, the independent sorts based on size and momentum have performed well in controlling for size with little variability in mean market capitalisation between the momentum portfolios within each size quintile. The one exception is within the largest quintile, where the loser portfolio has approximately half the mean (median) market capitalisation of the other four portfolios.

4. Portfolio Returns

4.1 Momentum Portfolio Returns

We now turn to the performance of the momentum strategy, which is to take a long position in the winner portfolio offset by a short position in the loser portfolio. We initially examine the traditional momentum strategy without the sort on size across the full sample. Table 3 reports the average and median monthly returns for the ten portfolios formed on the basis of past returns. Panel A reports equal-weighted portfolio returns while panel B reports value-weighted portfolio returns.

The results for the equal-weighted portfolios in Panel A indicate that all portfolios earn a mean and median monthly return that are significantly different from zero. Both an *F*-test and Kruskal-Wallis test (χ^2) are undertaken to test whether the ten portfolios have equal means and medians, respectively.[4] Neither test can reject the null hypothesis of equality of returns, indicating that there is no

4. We perform a parametric and non-parametric test because there is evidence that the returns for all the portfolios do not conform to a normal distribution. Results of the Kolmogorov-Smirnov test are similar to those reported herein and are available from the authors on request.

Table 2
Characteristics of Size and Performance-Ranked Portfolios

The table presents the average number of companies, and market capitalization, within each size-momentum portfolio at time of formation. The 25 size-momentum portfolios are formed by ranking all stocks by market capitalisation at the end of each formation period and assigning each stock to one of five size portfolios, where each size portfolio contains an equal number of stocks. Independently, all stocks are ranked by their prior six-month return and assigned to one of five portfolios containing an equal number of securities. This leads to the creation of 25 size-momentum portfolios.

	Winner	2	3	4	Loser
			Panel A: Number of Companies		
Big	42	60	51	33	11
2	46	47	47	37	21
3	44	38	41	42	33
4	39	30	33	43	52
Small	27	22	26	42	80
			Panel B: Mean Market Capitalisation ($ millions)		
Big	1304.35	1474.99	1538.39	1278.87	798.29
2	65.18	69.11	68.10	66.08	63.08
3	18.61	18.97	18.82	18.64	17.63
4	7.05	6.97	6.97	6.84	6.68
Small	2.46	2.42	2.38	2.33	2.13
			Panel C: Median Market Capitalisation ($ millions)		
Big	968.59	1033.81	1189.44	868.54	400.60
2	56.59	57.28	59.59	58.83	52.19
3	16.59	16.71	16.87	16.93	16.71
4	6.80	6.75	6.53	7.01	6.24
Small	2.41	2.39	2.17	2.24	1.98

evidence of a momentum effect for the equal-weighted portfolios. While the winner portfolio earns a positive return, the loser portfolio also earns a positive return which indeed is higher than the winner portfolio. Thus, the momentum portfolio earns a negative return, albeit not significantly different from zero.

Table 3
Returns to Performance-Ranked and Momentum Portfolios

The table presents the mean, median, standard deviation, *t*-statistic and *z*-value of equal-weighted (panel A) and value-weighted (panel B) monthly returns on each of the ten portfolios over the period 1979 to 2005 formed on the basis of prior six-month returns. ** and * denote significance at the 1% and 5% levels respectively.

Portfolio	Mean	Median	Standard Deviation	*t*-statistic (mean)	*z*-value (median)
			Panel A: Equal-Weighted Returns		

Winner	1.75	1.53	8.84	3.57**	4.46**
2	2.03	1.64	6.71	5.45**	6.40**
3	1.91	1.64	5.81	5.90**	6.57**
4	1.50	1.43	4.86	5.56**	6.28**
5	1.49	1.47	4.72	5.68**	5.87**
6	1.47	1.73	4.96	5.35**	5.88**
7	1.46	1.41	5.10	5.16**	5.60**
8	1.38	1.51	6.33	3.91**	4.42**
9	1.63	1.18	7.68	3.82**	3.68**
Loser	2.50	1.58	10.18	4.42**	3.90**
Momentum	-0.75	-0.02	8.17	-1.64	-0.81
F-statistic	0.86				
Kruskal-Wallis	2.59				
		Panel B: Value-Weighted Returns			
Winner	1.63	1.78	8.80	3.33**	4.95**
2	1.52	1.83	6.26	4.38**	5.62**
3	1.43	1.33	5.95	4.34**	6.09**
4	0.88	1.20	5.26	3.01**	4.19**
5	1.22	1.49	5.54	3.95**	5.33**
6	1.05	1.37	5.03	3.75**	5.00**
7	0.57	1.21	5.97	1.70	2.89**
8	0.34	0.59	6.45	0.95	1.65
9	-0.37	0.09	8.06	-0.83	0.43
Loser	-0.64	-0.24	10.58	-1.09	-0.33
Momentum	2.27	2.51	10.47	3.90**	4.09**
F-statistic	4.08**				
$\chi 2$	37.02**				

Turning to Panel B of Table 3 which presents the results for value-weighted portfolios, the results are quite different to those of Panel A. The *F*-test and Kruskal-Wallis test now indicate that the mean and median returns on the portfolios are significantly different from each other. Specifically, in Panel B, the winner portfolio again experiences a continuation in returns with a positive mean (median) monthly return of 1.63% (1.78%) per month, with the *t*-statistic and *z*-value indicating that the mean and median are both significantly different from zero. Moreover, there is now some evidence of a momentum effect in the loser portfolio which experiences a negative mean (median) return of -0.64% (-0.24%) per month. Hence, the net result for the momentum portfolio indicates that the trading strategy earns a significant positive return of 2.27% per month, which is significantly different from zero. That is, the relative difference between the respective winner and loser portfolios varies considerably under value-weighting compared to equal-weighting.

The findings in Table 3 support a momentum effect only in the value-weighted portfolios. The results indicate a continuation in returns for both the winner and loser portfolios when portfolio returns are calculated using value-

weights, but no evidence of this effect when portfolio returns are equal-weighted. As the Australian market is dominated by a relatively small number of large stocks, this implies that value-weighted portfolios will be dominated by these large stocks. Thus, these findings suggest that size may be a factor that interacts with momentum.

Table 3 also indicates that the standard deviations of the winner and loser portfolio are higher than any other portfolio. The winner and loser portfolios have standard deviations, respectively, that are 49% and 79% higher than the middle portfolios. This pattern is similar to that documented in overseas markets (Rouwenhorst, 1998; Hameed & Kusnadi, 2002). These results indicate that the extreme portfolios have higher unsystematic risk. This may be attributed to two factors. First, stocks with higher standard deviations would be expected to show unusual return attributes, all else being equal. Second, the selection of stocks with similar characteristics may lead to poorly diversified portfolios.

4.2 Size and Momentum Portfolio Returns

Recall that we construct 25 size-momentum portfolios. Our aim is to disentangle the separate effects of momentum and size. Following the process outlined above, the size-momentum portfolios are constructed and table 4 reports the average monthly returns for these portfolios. Again, panel A presents equal-weighted portfolio returns while panel B presents value-weighted portfolio returns.

From Table 4, and starting with the largest size quintile, the results clearly demonstrate that as we move from the winner to loser portfolios there is a steady decline in average monthly returns using either equal-weighted or value-weighted portfolio returns. A similar pattern is observed for the second and third largest portfolios. The *F*-test and Kruskal-Wallis test both indicate that there is a significant difference across the portfolio returns within the three largest size quintiles.

Focusing on the largest quintile and the winner and loser portfolios, the results suggest a clear continuation in returns in both extreme portfolios. The largest loser portfolio earns an average equal-weighted monthly return of -0.92% (-0.64% using value-weighted returns), while the largest winner portfolio earns an average monthly return of 1.71% (1.48% value-weighted). Hence the momentum portfolio earns an average monthly return of 2.63% (2.12% value-weighted), which is significantly different from zero. Note the similarity in the equal-weighted and value-weighted returns because size has effectively been neutralized across the portfolios within each quintile.

As we move down the size quintiles, a few observations are apparent. First, as size decreases, the continuation in returns on the winner portfolio stays relatively constant, with the largest increase in the mean monthly returns observed in the smallest portfolio. Second, the loser portfolio experiences a reversal in returns by the fourth size quintile. As with the winner portfolio, the loser portfolio within the smallest size quintile earns a large positive return. Third, the net result is that as size declines, the momentum strategy becomes less profitable and disappears completely in the smaller portfolios. That is, as size declines, there is a decrease in the cross-sectional variation in average returns between the portfolios within each size quintile.

Table 4
Returns to Quartile Sorted Size-Momentum Portfolios

The table presents the mean, *F*-statistic, χ^2 and standard deviation of equal-weighted (panel A) and value-weighted (panel B) monthly returns on each of the 25 size-momentum portfolios during the period 1979 to 2005. The 25 size-momentum portfolios are formed by ranking all stocks by market capitalisation at the end of each formation period and assigning each stock to one of five size portfolios, where each size portfolio contains an equal number of stocks. Independently, all stocks are ranked by their prior six-month return and assigned to one of five portfolios containing an equal number of securities. ** and * denotes significance at the 1% and 5% levels respectively.

	Winner	2	3	4	Loser	Momentum	F-stat	χ2
				Panel A: Equal-Weighted Returns				
Mean Monthly Returns								
Big	1.71	1.40	1.06	0.40	-0.92	2.63	5.58**	3.94**
2	1.73	1.31	0.97	0.14	-0.95	2.68	6.67**	5.31**
3	1.23	1.42	1.30	0.25	-0.50	1.73	4.16**	3.21**
4	1.51	1.67	1.23	1.40	1.25	0.27	0.62	0.24
Small	3.19	3.05	3.59	4.21	4.84	-1.66	-3.38**	-2.07**
F-statistic	11.60**							
χ2	181.45**							
Standard Deviation								
Big	6.61	5.01	4.62	5.80	9.70	8.48		
2	6.86	4.66	4.24	5.54	8.17	7.23		
3	7.98	5.43	5.09	5.40	8.56	7.50		
4	9.15	7.17	6.43	6.94	9.28	7.71		
Small	10.92	9.50	9.59	9.34	10.84	8.81		
				Panel B: Value-Weighted Returns				
Mean Monthly Returns								
Big	1.48	1.10	1.10	0.45	-0.64	2.12	4.36**	3.65**
2	1.76	1.30	1.01	0.10	-1.03	2.79	6.82**	5.60**
3	1.26	1.37	1.24	0.24	-0.52	1.78	4.20**	3.24**
4	1.45	1.71	1.20	1.24	1.15	0.30	0.70	0.31
Small	2.68	2.80	3.00	3.55	3.68	-1.00	-2.07*	-1.35
F-statistic	8.08**							
χ2	135.98**							
Standard Deviation								
Big	6.75	5.45	5.03	6.18	9.66	8.75		
2	6.77	4.66	4.31	5.66	8.30	7.36		
3	7.83	5.31	5.00	5.35	8.65	7.63		
4	9.02	7.18	6.38	6.81	9.13	7.70		
Small	10.98	9.52	9.15	9.02	10.54	8.69		

Within the smallest portfolio, we observe the well-documented size effect (Beedles, Dodd & Officer 1988; Durand, Juricev & Smith 2007; Gaunt 2004; Gaunt, Gray & McIvor 2000). In each of the five return groupings from winner to loser, the mean monthly return is always positive for the smallest portfolio. While not reported, the

effect is more pronounced if we decompose the sample further and sort into size deciles and conforms to previous evidence.[5]

Table 4 also reports the standard deviation of returns. First, consistent with the portfolios formed without the sort on size (as per table 3), the winner and loser portfolios within each size quintile always have a higher standard deviation in returns compared to the middle portfolios. Second, the loser portfolio always has a higher standard deviation of returns compared to the winner portfolio. Third, as size decreases the standard deviation of returns increases. Again, this latter finding is consistent with previous evidence concerning the size effect. Among the various arguments for this finding is the observation that small stocks typically have a lower price per share. This implies that small stocks are more likely to display higher volatility because a small change in price leads to a larger percentage change.

The findings in tables 3 and 4 allow us to reconcile the conflicting evidence of previous momentum studies in the Australian market. Previous studies in the Australian market that have employed a restrictive sample of stocks have biased their sample toward larger firms. These studies find evidence of a momentum effect (Demir, Muthuswamy & Walter 2004; Hurn & Pavlov 2003; Marshall & Cahan 2005). We find similar evidence of a momentum effect among the larger portfolios. However, Durand, Limkriangkrai and Smith (2006) use a broad sample of stocks and find little evidence of a momentum effect. Similarly, we find no evidence of momentum among the smaller portfolios.

To reconcile the previous evidence and illustrate the above point, table 5 presents the momentum effect across various size categories. We group stocks into four categories to align with previous studies. From table 5, there is clear evidence of a significant momentum effect in both equal-weighted and value-weighted portfolios for: the largest 50 stocks, the next set of stocks ranked 51–200, and the mid-cap stocks ranked 201–500. However, for the small-cap stocks ranked beyond 500, there is no evidence of a momentum effect. For the equal-weighted portfolios, there is a perverse momentum effect whereby the loser portfolio outperforms the winner portfolio, while returns on the value-weighted portfolio are not statistically different from zero. Thus, it is clear that momentum is present only in the larger half of the Australian equity market. This finding explains the inconsistent results of prior research.

In economic terms, the largest momentum returns are found in the group of stocks ranked 51-200 for equal-weighted portfolios and 201-500 for value-weighted portfolios, such that the mean monthly return is above 2%. Hence, there is a size effect to momentum, but it is a relative size effect among the larger half of the market. Importantly, once we move down the size categories, the additional momentum returns are substantially generated from declining performance of the loser portfolio rather than enhanced performance of the winner portfolio.

5. For instance, the average monthly return on the smallest decile portfolio is 4.71% (*t*-stat: 10.89).

Table 5
Returns to Size Grouped Portfolios

The table presents the mean, return from the winner, loser and momentum portfolios within four size group portfolios. T-statistics are presented in parentheses under the winner and loser portfolios. Within each size group, each stock is assigned to one of 10 momentum portfolio with the first portfolio (winner) comprises the top performing 10% of stocks whereas portfolio 10 comprises the bottom performing 10% of stocks (loser). The column 'Momentum' is the mean monthly return on the momentum portfolio. The table also reports a *t*-test and the z-value from the Wilcoxon rank sum test testing whether the winner and loser portfolio within each size portfolio have different mean and median returns respectively. ** and * denotes significance at the 1% and 5% level respectively.

Size Grouping	Winner (W)	Loser (L)	Momentum (W – L)	t-statistic (W – L)	z-value (W – L)
		Panel A: Equal-Weighted Returns			
Top 50	1.53 (3.69)**	-0.01 (-0.01)	1.54	3.84**	3.97*
51–200	1.83 (4.20)**	-0.60 (-1.29)	2.43	5.50**	5.27**
201–500	1.39 (2.82)**	–0.80 (–1.61)	2.20	4.88**	5.57**
501–	2.13 (3.61)**	3.67 (5.37)**	–1.54	–2.66**	-1.98*
		Panel B: Value-Weighted Returns			
Top 50	1.44 (3.27)**	0.02 (0.04)	1.42	3.29**	3.37**
51–200	1.72 (3.90)**	-0.39 (-0.83)	2.11	4.65**	4.40**
201–500	1.59 (3.20)**	–1.00 (–1.98)*	2.60	5.39**	6.01**
501–	1.74 (2.93)**	1.63 (2.64)**	0.11	0.21	0.90

5. Market Risk and SMB

The evidence from tables 3 and 4 indicates the standard deviations of returns on the winner and loser portfolios are higher than other portfolios. These findings are potentially consistent with cross-sectional variations in risk between the various portfolios (similar to Conrad & Kaul 1998) and exposure to a size premium. To investigate these issues, we follow Rouwenhorst (1998) and estimate a two-factor model that includes the traditional market risk premium proxy and the Fama and

French (1993) SMB factor.[6] The following time-series regression is then estimated:[7]

$$r_{pt} - r_{ft} = \alpha_p + b_p(r_{mt} - r_{ft}) + s_p SMB_t + \varepsilon_{pt} \quad (1)$$

Where r_{pt} is the return on portfolio p in month t, r_{ft} is the 13-week treasury note yield extracted from the AGSM-CRIF price relative files and r_{mt} is the value-weighted market monthly return extracted from the AGSM-CRIF price relative file. SMB is the return on the small portfolio less the return on the big portfolio. SMB is constructed by sorting all stocks by market capitalisation at the end of June and December into one of ten size portfolios, where portfolio 1 is the big portfolio and portfolio 10 is the small portfolio. Each size portfolio contains an equal number of stocks. The small and big portfolios are then held for the next six months and value-weighted returns are calculated.

Table 6 reports the results of estimating equation (1) on the ten portfolios (without any sort on size). The estimated beta coefficients generally lie around one, but with the winner and loser portfolios exhibiting higher than average exposure to market risk. The momentum portfolio has no exposure, as expected, as it is essentially a hedge portfolio. This holds for both equal-weighted portfolios (Panel A) and value-weighted portfolios (Panel B). The more interesting analysis is of the SMB coefficient. Turning to the equal-weighted portfolios in Panel A, the estimated coefficient on the size factor is significantly positive for all portfolios. Again, both the winner and loser portfolio exhibit strong exposures. The exposure of the momentum portfolio is also significant, but negative. However, this exposure is insignificant for the momentum portfolio on the value-weighted portfolios. In Panel B, the significant exposure to the size portfolios is mainly found in the extreme performing portfolios, which suggests that size again may be a related factor. Of note, the adjusted R^2 values are all quite large for the ten portfolios but fall dramatically for the momentum hedge portfolio.

To examine the impact of size, we re-run the regression in (1) on the 25 size-momentum portfolios. Table 7 presents the results from this analysis. That is, table 7 contains the estimated regression in (1) applied to the 25 portfolios formed earlier on the basis of size and momentum. Hence, table 7 parallels table 4. The left-hand columns of the table report the estimated coefficients while the right hand columns report the associated t-statistics.

6. It would be ideal to estimate the full Fama and French (1993) three-factor model but unfortunately there is no currently available database in Australia which contains accounting information back to 1979.
7. In unreported results we also estimate the one-factor market model. Further, we also estimate the model on decile portfolio formation as well as quintile formation. In all cases, for both equal-weighted and value-weighted portfolios, the regression results are similar and suggest that market risk alone cannot explain a majority of the cross-sectional variation in returns. For instance, across the decile portfolios, five of the ten intercepts are significantly different from zero. The results indicate that both the winner and loser portfolios have a higher market risk compared to the other portfolios, though each portfolio has a similar beta (1.19 and 1.06 respectively using equal-weighted returns and 1.25 and 1.22 using value-weighted returns). The analysis for the 25 size-momentum portfolios is similar and again indicates that the CAPM cannot explain the variation in excess returns on the portfolios. Again, the loser portfolios exhibit significant negative intercepts.

Table 6
Regression Estimates from the Two Factor Model using Momentum Portfolios

The ten portfolios are formed on the basis of prior six-month returns and each portfolio is held for six months. The following time-series regression is estimated

$$r_{pt} - r_{ft} = \alpha_p + b_p(r_{mt} - r_{ft}) + s_p SMB_t + \varepsilon_{pt}$$

Where r_{pt} is the return on portfolio p in month t, r_{ft} is the 13-week treasury note yield extracted from the AGSM-CRIF price relative files and r_{mt} is the value-weighted market monthly return extracted from the AGSM-CRIF price relative file. SMB is the return of the small portfolio less the return of the big portfolio. SMB is constructed by sorting all securities by market capitalisation at the end of June and December into one of ten size portfolios, where portfolio 1 is the big portfolio and portfolio 10 is the small portfolio. Each size portfolio contains an equal number of securities. The small and big portfolios are then held for the next six months and value-weighted returns are calculated. The *t*-statistic for the regression coefficients uses HAC standard errors. ** and * denotes significance at the 1% and 5% level respectively.

Portfolio	α_p	*t*-statistic	b_p	*t*-statistic	s_p	*t*-statistic	Adj R^2
			Panel A: Equal-Weighted Returns				
Winner	0.04	0.19	1.29	13.91**	0.94	11.61**	0.77
2	0.54	3.59**	1.01	19.12**	0.73	10.51**	0.81
3	0.51	3.76**	0.91	23.27**	0.61	12.34**	0.83
4	0.23	1.80	0.78	17.37**	0.46	16.47**	0.83
5	0.23	1.75	0.73	28.65**	0.50	15.92**	0.82
6	0.19	1.42	0.73	21.65**	0.55	14.45**	0.79
7	0.17	1.13	0.72	12.73**	0.56	9.46**	0.74
8	-0.05	-0.28	0.83	13.34**	0.75	10.01**	0.74
9	0.02	0.11	1.03	12.59**	0.95	10.70**	0.78
Loser	0.66	2.02*	1.20	10.46**	1.28	12.72**	0.70
Momentum	-1.34	-2.89**	0.09	0.56	-0.34	-2.02*	0.05
			Panel B: Value-Weighted Returns				
Winner	0.15	0.44	1.30	17.05**	0.44	3.35**	0.59
2	0.31	1.57	1.04	21.07**	0.12	2.23*	0.71
3	0.24	1.62	1.04	20.26**	0.08	1.32	0.79
4	-0.18	-1.22	0.91	23.37**	-0.09	-2.83**	0.79
5	0.10	0.65	0.92	27.12**	0.02	0.46	0.72
6	0.01	0.06	0.80	17.06**	-0.04	-0.98	0.66
7	-0.62	-2.99**	0.99	22.31**	0.11	2.25*	0.70
8	-0.84	-2.92**	0.90	8.23**	0.18	2.31*	0.50
9	-1.74	-5.48**	1.19	15.90**	0.30	3.35**	0.57
Loser	-2.22	-4.66**	1.29	12.55**	0.67	5.05**	0.45
Momentum	1.66	2.65**	1.30	17.05**	-0.22	-0.95	0.01

Several observations are apparent from table 7. First, when comparing across momentum quintiles, the winner and loser portfolios exhibit the largest exposure to the market factor, and are generally well above one. This result is consistent across all size quintiles and for both the equal-weighted and value-weighted portfolios.

Second, when comparing across size quintiles, the largest and smallest portfolios generally exhibit the highest exposure to the market factor. Third, the estimated coefficient on the size factor is consistently significant and positive. Fourth, exposure to the size factor is higher for the winner and loser portfolios. Fifth, exposure to the size factor increases inversely with size. Sixth, the momentum portfolios have no significant exposure to the market and size factor.

Table 7

Regression Estimates of the Two Factor Model using 25 Size-Momentum Portfolios

The 25 size and momentum portfolios are formed using independent sorts based on market capitalization and prior six-month returns over the period 1979 to 2005. The momentum portfolio is the return on the winner portfolio minus the return on the loser portfolio in each size quintile. The following time-series regression is estimated:

$$r_{pt} - r_{ft} = \alpha_p + b_p(r_{mt} - r_{ft}) + s_p SMB_t + \varepsilon_{pt}$$

Where r_{pt} is the return on portfolio p in month t, r_{ft} is the 13-week treasury note yield extracted from the AGSM-CRIF price relative files and r_{mt} is the value-weighted market monthly return extracted from the AGSM-CRIF price relative file. SMB is the return of the small portfolio less the return of the big portfolio. SMB is constructed by sorting all securities by market capitalisation at the end of June and December into one of ten size portfolios, where portfolio 1 is the big portfolio and portfolio 10 is the small portfolio. Each size portfolio contains an equal number of securities. The small and big portfolios are then held for the next six months and value-weighted returns are calculated. The *t*-statistic for the regression coefficients uses HAC standard errors. ** and * denotes significance at the 1% and 5% level respectively.

	Winner	2	3	4	Loser	Momentum
			Panel A: Equal-Weighted Returns			
Coefficient						
α_p						
Big	0.39	0.26	-0.05	-0.81	-2.33	2.00
2	0.29	0.13	-0.16	-1.11	-2.38	1.96
3	-0.38	0.12	0.03	-1.02	-2.09	1.00
4	-0.24	0.17	-0.19	-0.08	-0.52	-0.44
Small	1.35	1.37	1.96	2.56	2.91	-2.28
b_p						
Big	1.10	0.92	0.83	0.92	1.23	-0.12
2	1.06	0.73	0.66	0.80	1.01	0.06
3	1.17	0.74	0.66	0.68	1.13	0.04
4	1.20	0.87	0.76	0.78	1.15	0.06
Small	1.15	0.95	0.76	0.77	1.10	0.05
s_p						
Big	0.28	0.06	0.08	0.23	0.34	-0.06
2	0.56	0.31	0.28	0.42	0.60	-0.03
3	0.84	0.57	0.58	0.57	0.83	0.01
4	1.11	0.87	0.81	0.91	1.18	-0.07
Small	1.33	1.18	1.25	1.28	1.57	-0.24

Table 7 Continued

	Winner	2	3	4	Loser	Momentum
			Panel A: Equal-Weighted Returns Continued			
t-statistic						
Big	2.18*	2.39**	-0.40	-3.30**	-4.86**	3.70**
2	1.40	0.74	-0.95	-5.16**	-6.41**	4.55**
3	-1.66	0.65	0.18	-4.26**	-7.55**	2.22*
4	-0.91	0.79	-1.00	-0.43	-1.96	-0.98
Small	4.23**	5.14**	5.44**	7.61**	8.50**	-4.78**
Big	25.23**	19.82**	26.13**	13.45**	11.46**	-0.90
2	18.58**	12.68**	19.51**	12.38**	13.34**	0.50
3	18.01**	13.83**	19.01**	10.18**	11.69**	0.29
4	13.72**	14.29**	18.53**	16.99**	11.15**	0.33
Small	9.52**	13.18**	7.08**	10.61**	8.43**	0.37
Big	4.51**	2.42*	2.65**	3.68**	3.30**	-0.41
2	10.35**	8.01**	6.39**	5.57**	6.48**	-0.26
3	15.84**	12.55**	19.51**	7.69**	7.91**	0.08
4	17.79**	17.72**	15.66**	13.13**	20.05**	-0.67
Small	9.81**	14.12**	13.65**	13.04**	23.86**	-1.44
Adj R^2						
Big	0.72	0.86	0.84	0.65	0.42	0.00
2	0.73	0.69	0.69	0.63	0.48	0.00
3	0.77	0.70	0.70	0.62	0.63	-0.01
4	0.75	0.69	0.70	0.70	0.74	0.00
Small	0.61	0.60	0.56	0.61	0.75	0.02
			Panel B: Value-Weighted Returns			
Coefficient						
α_p						
Big	0.25	0.00	0.03	-0.72	-2.02	1.56
2	0.35	0.14	-0.12	-1.15	-2.45	2.09
3	-0.33	0.08	-0.01	-1.01	-2.10	1.05
4	-0.28	0.24	-0.21	-0.22	-0.59	-0.41
Small	0.84	1.10	1.38	1.90	1.74	-1.62
b_p						
Big	1.10	0.98	0.88	1.00	1.27	-0.16
2	1.04	0.74	0.68	0.81	1.02	0.03
3	1.16	0.73	0.65	0.67	1.13	0.03
4	1.19	0.86	0.76	0.76	1.13	0.07
Small	1.18	1.01	0.76	0.82	1.15	0.03
s_p						
Big	0.10	-0.06	-0.04	0.07	0.27	-0.17
2	0.53	0.29	0.26	0.40	0.58	-0.04
3	0.81	0.55	0.55	0.54	0.80	0.02
4	1.08	0.83	0.78	0.89	1.15	-0.06
Small	1.31	1.17	1.21	1.23	1.53	-0.22

Table 7 Continued

	Winner	2	3	4	Loser	Momentum
			Panel B: Value-Weighted Returns Continued			
t-statistic						
Big	1.12	-0.03	0.23	-3.06**	-4.83**	3.12**
2	1.63	0.77	-0.69	-5.06**	-6.66**	4.84**
3	-1.41	0.44	-0.07	-3.96**	-7.32**	2.29*
4	-1.07	0.99	-1.04	-1.21	-2.22*	-0.93
Small	2.57**	4.22**	4.25**	6.59**	5.84**	-3.35**
Big	20.78**	33.21**	26.05**	20.60**	14.66**	-1.39
2	18.24**	13.10**	17.30**	12.85**	13.19**	0.21
3	18.15**	14.69**	18.65**	9.09**	11.43**	0.18
4	13.65**	12.53**	17.57**	15.96**	11.12**	0.40
Small	9.22**	18.60**	6.62**	11.78**	10.10**	0.21
Big	1.29	-2.41*	-1.63	1.33	2.66**	-1.07
2	8.41**	7.65**	5.67**	5.23**	6.10**	-0.29
3	14.50**	13.08**	17.75**	7.59**	7.49**	0.10
4	16.66**	15.88**	14.04**	13.14**	19.84**	-0.60
Small	9.16**	14.92**	15.60**	12.00**	26.03**	-1.33
Adj R^2						
Big	0.69	0.86	0.80	0.67	0.45	0.01
2	0.71	0.69	0.68	0.61	0.47	-0.01
3	0.76	0.69	0.68	0.60	0.60	-0.01
4	0.74	0.65	0.68	0.69	0.73	0.00
Small	0.60	0.62	0.59	0.64	0.79	0.01

To put the results from table 7 in summary, the strongest exposure to the size factor is found in small loser portfolios which also have a strong exposure to market risk. To illustrate, the largest winner portfolio has an exposure to the size factor of 0.28, whereas the smallest loser portfolio has an exposure of 1.57.

The trend in the estimated intercepts from the two-factor model indicates that the estimate is significant for the smallest quintile and for the loser portfolios across all size groupings. This evidence concerning the loser portfolios is consistent with overseas evidence on momentum returns (Chan, Jegadeesh & Lakonishok 1996; Fama & French 1996; Jegadeesh & Titman 1993; Rouwenhorst 1998). The evidence that the winner portfolio does not outperform once various risk exposures are taken into account, means that excess returns to the momentum portfolio are driven by the continuing under-performance of the loser portfolio. This finding has significant ramifications as it casts doubt on the practical implementation of any momentum trading strategy because continual short positions in losing stocks would be required, and problems of illiquidity are likely to surface.

Finally, as a test of risk-adjusted momentum returns, we estimate the two-factor model as in (1) on buy-and-hold returns on the momentum portfolio. That is, the residuals are captured from the regression and represent risk-adjusted returns. Summary statistics of these excess returns are presented in table 8.

From table 8, we again observe positive and significant returns to the momentum portfolios but only in the larger stocks. These values can be compared to the unadjusted returns in Table 4. The risk adjustment has reduced the returns on average by 31% for the three largest portfolios. However, notwithstanding the above caveat, momentum returns appear to remain profitable. For the smallest portfolio, the momentum returns are significant but negative. This latter finding is consistent with our argument that at the smaller end of the market, there is no momentum, and indeed there is perverse momentum in risk-adjusted returns.

Table 8

Risk-Adjusted Returns on the Momentum Portfolio from the Two Factor Model

The momentum portfolios are formed using independent sorts based on market capitalization and prior six-month returns over the period 1979 to 2005. The momentum portfolio is the return on the winner portfolio minus the return on the loser portfolio in each size quintile. The following time-series regression is estimated for each momentum portfolio:

$$r_{pt} - r_{ft} = b_p(r_{mt} - r_{ft}) + s_p SMB_t + \varepsilon_{pt}$$

Where r_{pt} is the return on portfolio p in month t, r_{ft} is the 13-week treasury note yield extracted from the AGSM-CRIF price relative files and r_{mt} is the value-weighted market monthly return extracted from the AGSM-CRIF price relative file. SMB is the return of the small portfolio less the return of the big portfolio. SMB is constructed by sorting all securities by market capitalisation at the end of June and December into one of ten size portfolios, where portfolio 1 is the big portfolio and portfolio 10 is the small portfolio. Each size portfolio contains an equal number of securities. The small and big portfolios are then held for the next six months and value-weighted returns are calculated. The mean, median, standard deviation and the t-statistic of the residuals from the model are reported. ** and * denotes significance at the 1% and 5% level respectively.

	Mean	Median	Standard Deviation	t-statistic
		Panel A: Equal-Weighted Returns		
Big	2.00	1.59	8.47	4.24**
2	1.96	2.23	7.22	4.88**
3	1.00	1.50	7.53	2.38**
4	-0.44	-0.01	7.72	-1.02
Small	-2.28	-1.97	8.71	-4.71**
		Panel B: Value-Weighted Returns		
Big	1.56	1.65	8.67	3.23**
2	2.09	2.47	7.35	5.10**
3	1.05	1.58	7.66	2.47**
4	-0.41	-0.01	7.71	-0.97
Small	-1.62	-1.44	8.61	-3.39**

Finally, we recognize that seasonal patterns have been documented in most international equity markets with the most common being the January effect (e.g. Rozeff & Kinney 1976). The Australian evidence on seasonalities indicate that in addition to the January effect the market also experiences a positive seasonal effect in July (Brown, Keim, Kleidon & Marsh 1983; Durand, Juricev & Smith 2007),

although this result seems to be more prevalent in earlier time periods (Gaunt, Gray & McIvor 2000). Jegadeesh and Titman (1993) find that momentum profits are related to seasonalilty, such that the momentum strategy generates negative returns during January. Durand, Limkriangkrai and Smith (2006) find a similar result in Australia except the impact is most prevalent in July. To control for any potential seasonal effects we re-estimate equation (1) including monthly dummy variables. However, we find that there is little evidence of any significant seasonal effect changing our conclusions. Hence, for brevity we do not report these results.[8]

6. Conclusion

Prior evidence concerning momentum in Australian equity returns has produced inconsistent results. These studies have differed in their coverage of stocks and sample period. This prior evidence is suggestive of an interaction with firm size although this has not been examined in detail. Using a comprehensive set of stocks over 26 years, we closely follow the original design of Jegadeesh and Titman (1993), and commence the study by looking for the existence of momentum. Our initial findings reveal the existence of significant momentum returns only in value-weighted portfolios, again suggestive of an interaction with size. In further examination we report that momentum returns are significant only for larger portfolios, and that this finding explains the inconsistent results of prior research. Specifically, we demonstrate in various size groupings that momentum is present only in the top 500 stocks and most economically significant among the 201–500 size grouping. Hence, there is a size effect to momentum, but it is a relative size effect among the larger half of the market. The increase in momentum returns is primarily generated from poorer performance of the loser portfolio rather than any superior performance of the winner portfolio. The difficulties of maintaining short positions in losing stocks, combined with the relatively illiquid nature of the mid-cap market in Australia, leads us to conclude that our evidence casts doubt on the practical implementation of a successful momentum trading strategy.

To more formally examine the impact of size, we run a two-factor model that includes the SMB factor, and find significant exposure to this factor among the combinations of size and performance portfolios. The strongest exposure to the size factor is found in small loser portfolios which also have a strong exposure to market risk. This analysis allows for the construction of risk-adjusted returns, and we find evidence that the winner portfolio does not outperform once various risk exposures are taken into account, but rather any excess returns to the momentum portfolio are driven by the continuing under-performance of the loser portfolio. The risk adjustments generally reduce returns by around 30%. Again, these findings cast doubt on the practical implementation of any momentum trading strategy as continual short positions in losing stocks would be required, and illiquidity concerns arise.

In summary, our study explains the inconsistent findings of previous research, and documents that momentum returns in Australia are related to relative size, but only among larger stocks. On closer examination, we find evidence supporting an explanatory size factor, and show that it is continued under-performance in the

8. These results are available from the authors on request.

smaller loser portfolios that drives the appearance of momentum profits. In this respect, successful momentum trading strategies are likely to realize 'paper' profits rather than generate real investment returns.

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