“The small firm and other confounding effects in asset pricing data: some evidence from Australian markets”

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The small firm and other confounding effects in asset pricing data: some evidence from Australian markets

Abstract

In Australian markets, authors seek to clarify the relationship of stock return performances with their beta, firm market capitalization and trading activity. This study leads us to consider the possibility that asset pricing studies can be dominated by the stocks of the very small companies to the extent of having little relevance to institutional share management. For example, the paper observes how the pattern of returns for stocks of the very small firms leads to generalizations that are reversed in respect to the stocks of larger firms. Additionally, the study reveals how outcomes may be compromised by "reversals of causality" in the data, so that, for example, beta estimates may be the outcome, rather than the explanation of stock price performances. Overall, the paper finds that when the stocks of the very small firms are removed, stock returns have a positive relationship with firm capitalization, while bearing no pronounced relation to either of stock beta or trading activity.

Keywords: multifactor model, beta, size effect, liquidity.
JEL Classification: G10, G12, G15.

Introduction

This paper seeks to examine how the return performances of Australian equities relate to a company's stock beta, market capitalization and liquidity. In following our inquiry, the analysis suggests the existence of confounding effects that may need to be recognized in making meaningful interpretations of the data – and which do not appear to have been fully recognized in the context of Australian markets.

Firstly, in this regard, we draw attention to the possibility of "reversals of causality" in the data, whereby, due to the effects of momentum in sustaining stock and market price trends, beta may come to be measured as the outcome of idiosyncratic stock performances – as opposed to stock performances being the outcome of their beta, as implied by the capital asset pricing model (CAPM). To be more specific, a significant number of stocks of small companies have continued to perform well in otherwise declining markets – and consequently have quite high returns and low (or even negative) betas. And, additionally, stocks of large companies have on occasion led the market downward – with consequent low returns and very high betas.

Secondly, we reveal that the small firm size effect is embodied differentially in the stocks of the very small firms, to such a degree that outcome results from regression analyses are likely to be misleading in relation to the stocks of larger firms. For example, although the relation of higher portfolio returns with smaller firm size is evident, and is indeed dramatic, at the lower end of firm capitalizations, the relation is actually reversed for stocks of larger capitalization.

As well as achieving a degree of clarification on these issues, our material conclusions may be summarized as follows. Equally-weighted returns of portfolios of Australian stocks with higher beta generally exceed the returns for portfolios with lower betas. Further, for the cohort of small sized firms, returns increase dramatically with decreasing firm size. When, however, we exclude the stocks of the small-sized firms, our findings are negated or even reversed. Thus, stock returns no longer bear a clear relationship with their beta, and we encounter a positive relationship between portfolio stock performances and firm size.

The portfolio method of analysis used in the study is the method advocated by the late Fischer Black (Black, 1993; Mehrling, 2005, p. 112). We apply it to calculate stock returns across compartmentalized ranges of stock beta, firm size and liquidity. Although it lacks statistical tests – as compared with, for example, the Fama and Macbeth (1973), Fama and French (1992) method – Black's argument was that the method simulates the portfolios that investors might actually use, and rather than providing a "once-off" analysis, the method tends to give guidance as to where to look for the next most promising theoretical enhancements. And unlike linear regression tests, the portfolio method does not assume any specific functional form for the relations among the variables. An additional benefit of the more descriptive portfolio approach is that, rather than focusing on well-specified findings so as to justify the paper, we are able to cross between apparent contradictions in the literature with a view to achieving a level of harmony.

The rest of the paper is organized as follows. Section 1 reviews prior literature. Section 2 describes the data and the methodology employed in this paper. In Section 3 we discuss the results and the last Section concludes.

We gratefully acknowledge financial support from the Melbourne Centre for Financial Studies.

1. Background

Traditional finance theory as represented by the CAPM (Sharpe, 1964; Lintner, 1965) posits that an investor's required expectation of return on a risky asset in excess of the risk-free rate is determined as that risky asset's beta (the covariance or its returns with market returns) multiplied by the expected return on the market in excess of the risk-free rate. Notwithstanding, a range of variables not explicitly acknowledged by the CAPM have subsequently been identified as having explanatory power for stock returns. For example, it is documented that factors such as firm capitalization and book-to-market equity (Banz, 1981; Rosenberg, Reid and Lanstein, 1985; Fama and French, 1992; 1993; 1996 and 1998), liquidity (Amihud and Mendelson, 1986; Amihud, 2002), leverage (Bhandari, 1988) and idiosyncratic volatility (Malkiel and Xu, 1997; 2006; Goyal and Santa-Clara, 2003) have explanatory power for cross-sectional variations in stock returns.

In the Australian market, Ball, Brown and Officer (1976) originally found evidence of a positive relationship between average returns and beta for a sample of industrial firms. However, Wood (1991) found only weak evidence in Australian markets and Faff (1991) finds only moderate evidence, while Faff (2001a) reports that there is no relationship between beta and returns for the standard CAPM. In the context of Australian markets, Halliwell, Heaney and Sawicki (1999) replicate the Fama and French (1993) three-factor study and find that the significance of beta and market capitalization is generally comparable with the determinations of Fama and French, but that the book-to-market equity variable has little explanatory power. However, Faff (2001b) and Gaunt (2004) in the context of the three-factor model, find that the book-to-market equity variable is significant in explaining stock returns in Australian markets.

With confirmation of the Fama and French three-factor model, a consideration of a company's market capitalization or firm size effect has become almost standard practice. Nevertheless, not all the evidence all one-sided. Banz (1981), for example, documents the size effect over a 45-year period for U.S. stocks and finds that while the effect is pronounced in the smallest firms there is no clear linear relationship between firm size and returns. Horowitz, Loughran and Savin (2000) conclude that the size effect is no longer prevalent in U.S. stocks. In the Australia market, Beedles, Dodd and Officer (1988) find that the size effect is prevalent and is robust to several methodological adjustments. They find evidence that transaction costs can explain a part of the size anomaly but that they do not appear to be the dominant factor. Other studies, however, find little or no evidence of the firm size effect in Australian markets. Brown, Kleidon and Marsh (1983) find that although the size anomaly exists, it is nevertheless not stable through time and that estimates of the size effect are subject to the historical time studied. Consistent with the findings of Banz in the U.S., they find that the relationship between firm size and returns is located in the smallest stocks. Chan and Faff (2003) report a flat regression between returns and market capitalization for Australian stocks, and Gaunt (2004) finds no clear evidence of the firm size effect in Australian markets.

In Australian markets, Beedles, Dodd and Officer (1988) have found that large firms have greater liquidity and suggest that liquidity partially explains the size effect (for example, Amihud (2002) in the U.S.), while Anderson, Clarkson and Moran (1997) by comparing the largest 50 firm stocks to the smallest 50 firm stocks in the Australian market find no significant relationship between abnormal returns and liquidity. Also in the Australian market, Chan and Faff (2003) use share turnover as a proxy for liquidity and find that turnover is negatively related to stock returns and that the effect persists after controlling for book-to-market, size, beta and momentum. Marshall and Young (2003) examine liquidity in the Australian market and, consistent with Chan and Faff, find evidence of a negative relationship between share turnover and stock returns.

2. Data, variables and methodology

2.1. Data. We obtained the data for this study from two sources. The Australian Graduate School of Management (AGSM) equities database was used to calculate beta and idiosyncratic volatility. The Securities Industry Research Centre of Asia-Pacific (SIRCA) database, which includes daily returns and daily trading volume for Australian equities from 1980 through 2004, was matched with the AGSM database. The SIRCA data were used to calculate liquidity.

In order to be included in the sample for a given month, a stock must have been traded in 35 of the previous 60 months (to calculate the stock's beta for that month) and have traded in that month and the previous two months (to calculate liquidity). Our final sample included 190,218 monthly observations of 2,347 corporations. In any month, the number of companies ranged from just less than 200 to more than 1,000. Company sizes ranged from market capitalizations from \$30,000 to \$46 billion (with an average capitalization size of approximately \$400 million). In the two-dimensional sorts, the minimum number of observations assigned to any portfolio was 270.

2.2. Measurement of variables. On a monthly basis, the variables for the analyses were measured as follows.

2.2.1. Measurement of stock returns ($r_{i,t}$). The return ($r_{i,t}$) for stock i is measured as:

$$r_{i,t} = \frac{p_{i,t+1} - p_{i,t}}{p_{i,t}} - r_f,$$

where $p_{i,t}$ is the dividend-adjusted price of the stock at the end of month t, and r_f is the risk-free rate proxied as the three-month Treasury bill rate.

2.2.2. Measurement of stock betas ($\beta_{i,t}$). Beta ($\beta_{i,t}$) for each stock i at the end of each month t is calculated from the previous 60 months of historical data as:

$$\beta_{i,t} = \frac{cov(r_i, r_M)}{var(r_M)},$$

where r_i and r_M are the returns from stock i and the market index M, respectively, over months $m = t - 59$ to month t. If a stock did not trade for at least 35 out of the previous 60 months, it was not included in that month's t calculation.

2.2.3. Stock liquidity ($LIQ_{i,t}$). Liquidity for stock i at the end of month t ($LIQ_{i,t}$) is defined as the ratio of the average monthly volume of trade in the three ($t - 2$, $t - 1$, t) months to the number of shares outstanding in month t.

2.2.4. Market capitalization (*company size*) ($MC_{i,t}$). The market capitalization of stock i at the end of month t ($MC_{i,t}$) is measured as the number of company i's shares outstanding multiplied by the share price at the end of month t.

2.3. Methodology. Stocks are ranked on their market capitalization (MC) in month t and partitioned as ten portfolios with the same number of stocks in each portfolio. For each portfolio constructed at month t the monthly equal-weighted and value-weighted realised returns are calculated for the following month $t + 1$. The portfolios are rebalanced each month based on beta, and a time-series average of the monthly equal-weighted and value-weighted returns is calculated for each portfolio decile. The same procedure is used for the market capitalization (MC) and liquidity (LIQ) variables.

We proceed to observe the extent to which a sort of portfolios on one variable (either market capitalization or idiosyncratic variance) is a sort on the other variable. Finally, we form a set of 100 (10x10) portfolios across pairs of the variables beta and MC, which allow us to identify the pattern of returns on one variable while holding the other variable constant.

A comment on the formation of the above 10x10 portfolios is warranted. In double sorts on two variables aimed at controlling for the first variable while observing the impact of the second variable, the more usual approach is to sort first on the controlled variable into 10 portfolios before each such portfolio is sorted into a further 10 portfolios on the second variable. The problem here is the high correlation of our explanatory variables, which implies that a sort on the first variable will also effectively be a sort on the second variable, with only a very limited range of portfolio-averaged values for portfolios formed on the second variable. For this reason, we adopt the approach of forming portfolios on the maximum spread of the values of the second variable free of the restriction that each portfolio must have an equal number of stocks. Thus we create 10x10 sorts for each pair of variables by referencing each stock to each of its decile portfolios. For example, a stock that appears in the decile 1 portfolio for the β variable and decile 1 portfolio for the MC variable appears in the percentile portfolio (1, 1), while a stock that appears in decile portfolio 1 for the β variable and decile 2 portfolio for the MC variable appears in the percentile portfolio (1, 2), and so on.

3. Results

3.1. Single sort portfolios. Figure 1 displays the relationship for portfolio excess equally-weighted (EW) and value-weighted (VW) returns on their average beta. The corresponding values are tabulated in Panel A of Table 1. The Table also presents average values of market capitalization (MC) and liquidity (LIQ) for each of the portfolios. We draw attention to the broad characteristics within the compartmentalized ranges of the beta portfolios as follows. The equally-weighted average returns are broadly increasing with beta as portfolios 3-9, that is, from beta approximately 0.25 to beta approximately 2.25. Within this range, the central portfolios (5-6) with beta in the range 0.65-1.3 have the highest average firm capitalization (averaging approximately \$650 million per firm), while the portfolios for both lower beta portfolios (3-4) and higher beta portfolios (8-9) have market capitalization averaging approximately \$300 million per firm. The portfolios of the very low beta portfolios (1-2) and high beta portfolio (10) have the low market capitalizations (averaging approximately \$75 million per firm). The lowest beta portfolio (1) stocks actually have the highest average returns. No theory of asset pricing is able to predict such outcomes. We observe also that the highest beta portfolio (10) has the highest liquidity, and that the liquidity generally decreases with portfolio beta before rising again for the very low beta portfolio.

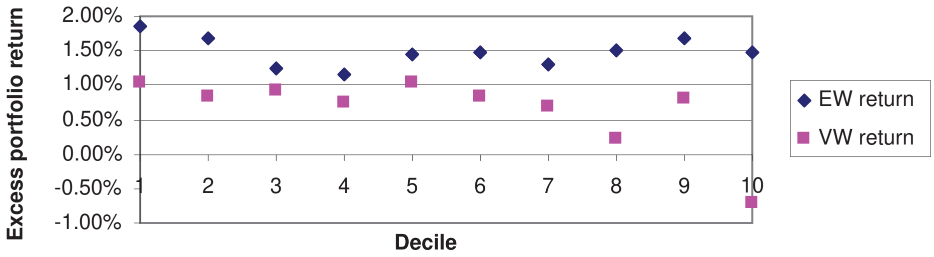

Fig. 1. Average monthly return and beta

Table 1. Average monthly returns of portfolios formed on stock beta, market capitalization and liquidity

Panel A: Portfolios formed on beta (as Figure 1)										
Portfolio	1	2	3	4	5	6	7	8	9	10
Beta compartment	$\beta < 0.25$		$0.25 < \beta < 0.65$		$0.65 < \beta < 1.3$			$1.3 < \beta < 2.25$		$\beta > 2.25$
Average β	-0.29	0.21	0.39	0.56	0.73	0.91	1.13	1.44	1.85	2.63
EW return	1.87%	1.68%	1.24%	1.16%	1.43%	1.48%	1.29%	1.52%	1.69%	1.48%
VW return	1.04%	0.85%	0.91%	0.76%	1.03%	0.83%	0.70%	0.22%	0.80%	-0.71%
Average *MC* (m)	$60	$145	$222	$366	$625	$670	$629	$375	$219	$69
Average *LIQ*	1.9%	1.5%	1.6%	1.7%	2.1%	2.3%	2.65%	3.25%	3.7%	4.6%
Panel B: Portfolios formed on market capitalization (as Figure 2)										
Portfolio	1	2	3	4	5	6	7	8	9	10
Average *MC* (m)	$1.9	$4.2	$7.25	$11.6	$18.0	$29.4	$52.3	$106.8	$284.8	$2,074.0
EW return	7.46%	2.25%	0.94%	0.81%	0.34%	0.54%	0.53%	0.69%	0.68%	0.73%
VW return	5.84%	2.19%	0.93%	0.80%	0.32%	0.54%	0.52%	0.68%	0.66%	0.74%
Average β	1.1	1.1	1.1	1.0	1.0	0.9	0.9	0.9	0.9	1.0
Average *LIQ*	3.0%	3.25%	3.2%	2.9%	2.8%	2.4%	2.1%	1.9%	1.8%	2.15%
Panel C: Portfolios formed on liquidity (as Figure 4)										
Portfolio	1	2	3	4	5	6	7	8	9	10
Average *LIQ*	0.10%	0.32%	0.56%	0.83%	1.16%	1.57%	2.11%	2.90%	4.37%	9.56%
EW return	1.77%	1.38%	1.47%	1.39%	1.36%	1.43%	1.46%	1.60%	1.52%	1.62%
VW return	0.55%	0.51%	0.75%	0.77%	0.66%	0.72%	0.59%	0.58%	0.69%	0.75%
Average β	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.45
Average *MC* (m)	$324	$115	$138	$166	$244	$434	$584	$595	$527	$250

Notes: We calculate average monthly returns for portfolios formed on stock beta (β), market capitalization (*MC*) and liquidity (*LIQ*). In each month, *t,* all stocks are ranked separately on beta, capitalization and liquidity. Both equally weighted (EW) and value-weighted (VW) average monthly returns are calculated for each portfolio. The portfolios are rebalanced monthly. The returns in the Table are the average for each portfolio during the period. Panel A reports returns for portfolios formed on beta; decile 1 is for stocks with the lowest beta. Panel B reports returns for portfolios formed based on market capitalization; decile 1 is for the lowest market capitalizations. Panel C reports returns for portfolios formed based on liquidity; decile 1 is for the least liquid stocks.

The excess value-weighted returns for the beta portfolios are also presented in Panel A of Table 1 and Figure 1. The value-weighted average returns are actually *decreasing* (with some irregularity) for portfolios with beta greater than about 0.7 (portfolio 5) to beta of 2.63 (portfolio 10) which has a negative return of 0.71% per month. Again, no theory of asset pricing is able to predict such outcomes. In seeking to explain the structure of value-weighted returns on beta, we consider the following. It is possible to conjecture that we are witnessing a reversal of causality between beta and return performances in the data. For example, when stocks of large companies (banks or Qantas or Telstra, for example) lead the market down, such stocks have negative returns and highly positive betas. Similarly, when stocks of smaller companies have gone against the market by performing unexpectedly well during market declines (resource stocks, for example), they exhibit positive returns and, therefore, negative betas. More specifically, as well as being explanatory of equity performance, beta is capable of being the outcome of equity performance. The market is not, after all, to be regarded as a series of one-period investments as a laboratory for testing static asset pricing models. In which case, we cannot expect that the CAPM will be readily verified by the data, as has generally been the experience for Australian studies. For example, Wood (1991) finds only weak evidence for the CAPM in Australian markets, while Faff (1991) finds only moderate evidence, and Faff (2001a) reports that there is no relationship between beta and returns for the standard CAPM.

The returns on beta for the equally-weighted average returns are significantly higher than for the value-weighted average returns (Figure 1). Further, the recorded excess equally-weighted returns are actually very high – the returns of about 1.4% (monthly) for the portfolios with more typical betas (0.65-1.3) are roughly twice the return for the actual market (closer to 0.75% per month). The implication is that the returns for stocks of small firms are higher than the returns for stocks of larger firms. We demonstrate this in Figure 2. The results are tabulated in Panel B of Table 1. The relationship of Figure 2 appears to be broadly consistent with the inverse relationship between returns for U.S. stocks and their market capitalization as reported by Spiegel and Wang (2005). We note, however, that this inverse relationship holds only for firms with extremely low market capitalizations. Indeed, the average portfolio returns tabulated in Panel B of Table 1 reveal that for portfolios 5-10 in Figure 2, returns are actually *increasing* with market capitalization. Our findings are broadly consistent here with Banz (1981) for the U.S. and Gaunt (2004), Brown et al. (1983), and Beedles et al. (1988) for Australia, who find that the size effect holds only for the smallest stocks. Although Chan and Faff (2003) report a flat regression relationship between returns and market capitalization for Australian stocks, it is possible that the stocks driving the return performance of our portfolios 1 and 2 have been suppressed in their linear regression analysis. We may note that portfolio 10 of Panel B, Table 1 broadly encompasses the top 100 of stocks by market capitalization, which has an average excess monthly return of 0.74%, and a beta equal to 1.

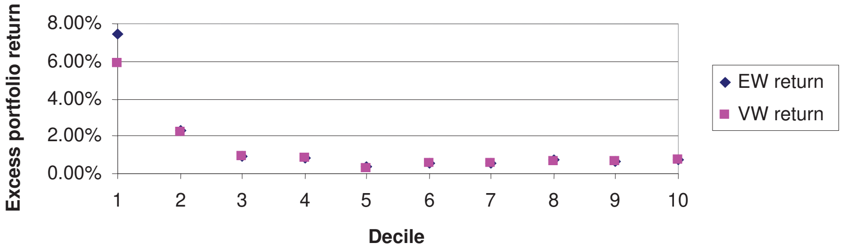

Fig. 2. Average monthly return and market capitalization

We proceed to differentiate between the explanatory power of the variables beta and market capitalization by forming a pair-wise sort on these variables. The approach allows the explanatory power of one variable to be examined while controlling for the explanatory power of a second variable. Figure 3 with Table 2 serves to demonstrate again the dominance of the returns of the very small firms on the data. In particular, we observe that the relationship between equally-weighted returns and beta, as depicted in Figure 1, appears to derive predominantly from the contribution of the lowest market capitalized stocks.

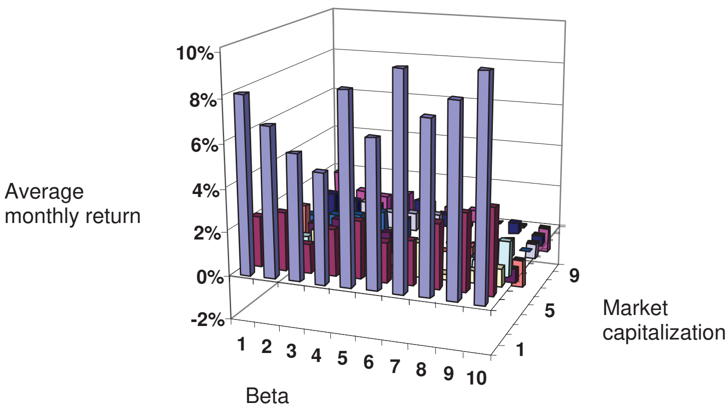

Fig. 3. Average monthly returns on beta and market capitalization

Table 2. Average monthly returns of portfolios formed by a two-dimensional sort on beta and market capitalization

Average monthly returns on beta and market capitalization (as Figure 3)										
	β1	2	3	4	5	6	7	8	9	β10
MC 1	8.17%	6.87%	5.76%	5.04%	8.71%	6.77%	9.75%	7.81%	8.64%	9.90%
2	2.37%	2.67%	1.33%	2.15%	2.67%	1.84%	2.05%	2.97%	3.54%	3.92%
3	1.92%	0.95%	1.64%	0.40%	0.93%	0.23%	1.59%	0.28%	0.58%	0.83%
4	-0.08%	0.83%	0.55%	0.66%	0.24%	-0.01%	1.26%	-1.33%	0.64%	1.66%
5	0.63%	1.11%	1.46%	0.72%	1.06%	0.78%	0.13%	0.52%	0.15%	-0.67%

Table 2 (cont.). Average monthly returns of portfolios formed by a two-dimensional sort on beta and market capitalization

Average monthly returns on beta and market capitalization (as Figure 3)										
	β1	2	3	4	5	6	7	8	9	β10
6	1.41%	0.48%	0.71%	0.33%	0.29%	-0.97%	0.02%	0.41%	0.13%	-1.29%
7	0.60%	0.73%	0.87%	1.16%	0.88%	0.67%	-0.03%	-0.57%	0.31%	0.01%
8	-0.91%	0.86%	1.16%	0.79%	0.86%	0.90%	-0.20%	0.74%	-0.78%	-0.73%
9	1.03%	0.77%	0.65%	1.28%	1.12%	0.56%	0.16%	0.11%	0.54%	-0.44%
MC 10	1.81%	0.97%	0.79%	1.03%	0.66%	0.61%	0.55%	-0.05%	-0.09%	-1.15%

Notes: We calculate average monthly returns for portfolios formed based on pairs of beta (β) and market capitalization (*MC*). In each month *t* each stock is ranked separately on the variables (β, *MC*) and allocated to a decile portfolio (1-10 as in Table 1, Panels A and B). Portfolios 1-100 are then formed based on variable pairs according to the cross rankings of their allocations to portfolios 1-10. For example, a stock from portfolio 1 of the lowest betas and from portfolio 1 of the lowest market capitalization is assigned to portfolio (1, 1), a stock from portfolio 1 of the lowest betas and from portfolio 2 of the next-to-lowest market capitalization is assigned to portfolio (1, 2), and so on. Equally-weighted (EW) average monthly returns are calculated for month *t* for each portfolio. The portfolios are rebalanced monthly. The returns in the Table are the average for each portfolio over the period.

Finally we turn to clarify the significance of the stock's trading activity as liquidity. Figure 4 reveals a more or less flat relationship. The results are tabulated in Panel C of Table 1. The literature generally (Chan and Faff, 2003; for Australian data) reports a negative relationship between stock returns and the liquidity measure used here. Such a direction of causality might reverse itself, however, if stocks tend to trade more frequently as they increase in value. Notwithstanding, our findings are consistent with Anderson et al. (1997) who fail to find a strong relationship between returns and liquidity in the Australian market. In Panel C of Table 1, we note that the average betas in a portfolio are increasing with portfolio liquidity. Thus, it is possible that the more a company's stocks have recently been "churned", the more sensitive they are to market movements. We note also from Panel B of Table 1, that a portfolio's liquidity is generally decreasing with market capitalization (which we might understand as the outcome of dividing the number of traded shares by the number of shares outstanding consistent with the definition of liquidity) – right up to the portfolio (10) of the largest capitalized stocks, for which liquidity is quite abruptly increased (as we expect for institutionally-traded stocks). In Panel C, however, this trend is apparently contradicted, since the portfolios of greater liquidity are of larger capitalized firms, apart from for the very highest liquidity portfolio (10) which is identified with firms of lower market capitalization. The explanation is that the largest capitalized stocks with high liquidity which are partitioned into a single portfolio in Panel B, are distributed across portfolios in Panel C so as to dominate the observed positive trend of increasing firm size with increasing liquidity. So again we observe how caution must be exercised in interpreting statistical outcomes.

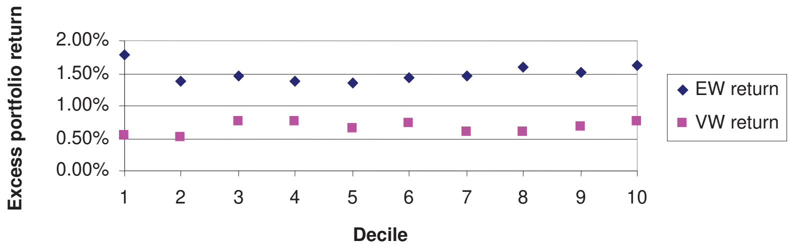

Fig. 4. Average monthly return and liquidity (share turnover)

Conclusion

Our analysis suggests the existence of confounding effects that may need to be recognized in making meaningful interpretations of the data – and which do not appear to have been fully recognized in the context of Australian markets. Firstly, the desire of researchers to maximise the statistical significance of their data encourages the inclusion of firms of a very small capitalization. In computing equally-weighted averages, however, the inclusion of such firms is capable of dominating outcomes to such an extent as to contradict relationships that are likely relevant to the domain of firms of interest to institutional ownership. And, secondly, we have observed the possibility that as well as being explanatory of equity performance, the variables of beta and liquidity are capable of being the outcome of equity performance. Such findings are likely to work against verification of the CAPM in the data. As well as achieving a degree of clarification on these issues, the paper's main conclusions are summarized as follows. When the smallest capitalized stocks are excluded, a dramatic inverse relationship of returns with firm size disappears, becoming positive. In the reduced data set, there appears to be no general tendency for either beta or trading activity to markedly influence the overall pattern of returns.

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