“Are company size and stock beta, liquidity and idiosyncratic volatility related to stock returns? Australian evidence”

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ARTICLE INFO	Bernard Bollen, Louise Clayton, Michael Dempsey and Madhu Veeraraghavan (2008). Are company size and stock beta, liquidity and idiosyncratic volatility related to stock returns? Australian evidence. *Investment Management and Financial Innovations*, *5*(4-1)
RELEASED ON	Thursday, 15 January 2009
JOURNAL	"Investment Management and Financial Innovations"
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

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Abstract

The degree to which any one of a firm's beta, market capitalization, stock liquidity or idiosyncratic volatility of stock returns may be a proxy for one or more of the other variables in explaining the cross-sections of market return performances remains controversial. In the context of Australian markets, we reveal how return performances appear to relate to these variables individually as well as in combination. The paper's main conclusions are as follows. We find no general tendency for any of the considered variables of beta, market capitalization, liquidity or idiosyncratic volatility, to influence the overall pattern of returns for large capitalized Australian stocks. However, the smallest capitalized stocks markedly outperform the largest capitalized stocks, and for such small capitalized stocks those with greater idiosyncratic volatility have markedly superior returns. It appears therefore that we have little evidence to support the notion that asset pricing models for Australian markets might be successfully related to these variables.

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

Introduction

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.

The evidence on these issues, however, has not always been one-sided. For example, Constantinidies (1986) argues that the transaction costs associated with liquidity can be minimized by less frequent trading so that liquidity does not constitute a first-order effect; Horowitz, Loughran and Savin (2000) argue that the size effect is no longer prevalent in US stocks; and Bali, Cakici, Yan and Zhang (2005) dispute the findings of Goyal and Santa-Clara in relation to idiosyncratic volatility and show that their results are driven by small stocks and are partially attributable to a liquidity premium. Notwithstanding, the Fama and French (1993) three-factor model incorporating firm capitalization and book-to-market ratio alongside firm beta is now widely applied.

In separating the influences of market capitalization, stock liquidity and idiosyncratic volatility in US markets, Spiegel and Wang (2005) find that companies with high idiosyncratic volatility tend both to small capitalization and low liquidity, and that stock returns are increasing with idiosyncratic volatility (and decreasing with a stock's capitalization and liquidity). They conclude that while all these variables appear to bear a systematic relationship with a stock's returns, the relationship of idiosyncratic volatility with a stock's returns subsumes the relationships of both capitalization and liquidity with returns.

In this paper, we follow an approach similar to that of Spiegel and Wang, for Australian equities over the period of 1980-2003. We are motivated by the sparseness of papers relating to the performances of stock returns in Australian markets, as well as by the need to substantiate findings in US markets with non-US studies. The paper's main conclusions are summarized as follows. There appears to be no general tendency for any of the considered variables of beta, market capitalization, liquidity or idiosyncratic volatility, to influence the overall observed pattern of larger capitalized Australian stock returns. However, the smallest capitalized stocks markedly outperform the largest capitalized stocks, and for such small capitalized stocks those with greater idiosyncratic volatility have markedly superior returns. It appears therefore that we are left with little evidence to support the notion that asset pricing models for Australian markets might be successfully related to these variables.

We gratefully acknowledge financial support from the Melbourne Centre for Financial Studies (Cost Centre B07005 and 1779270). Any errors are our own.

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

1. Background

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 such 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 magnitude and statistical significance of the beta, market capitalization and book-to-market equity variables are generally comparable with the determinations of Fama and French. Faff (2001b) and Gaunt (2004) have also demonstrated the application of the three-factor model in the Australian market.

With confirmation of the Fama and French three-factor model, a consideration of a company's market capitalization or 'size effect' has become almost standard practice. Nevertheless, the evidence is not all one-sided. Banz (1981), for example, documents the size effect over a 45 year period for US stocks and finds that while the effect is pronounced in the smallest firms there is no clear linear relationship between firm size and returns; and Horowitz, Loughran and Savin (2000) conclude that the size effect is no longer prevalent in US 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 US, they find that the relationship between firm size and returns is located in the smallest stocks. Chan and Faff (2003) report a flat regression relationship between returns and market capitalization for Australian stocks for the more period of 1990-1999, and Gaunt (2004) finds no clear evidence of the firm size effect in Australian markets.

Malkiel and Xu (1997) show a high negative correlation between a company's size and its idiosyncratic volatility and suggest that idiosyncratic risk might explain the size effect. They consider that idiosyncratic risk is rationally priced if portfolio managers must justify (to clients) the performance of individual stocks within their portfolios, while Malkiel and Xu (2006) provide a formal model consistent with idiosyncratic risk being priced when investors (either voluntarily or non-voluntarily) are incompletely diversified. Similar to the approach adopted here, Malkiel and Xu (1997) divide stocks into portfolios based on their idiosyncratic volatility and report their average return over the period 1963-1994. The results show a clear trend for stocks with higher idiosyncratic risk to generate higher returns. Ang, Hodrick, Xing and Zhang (2006), however, dispute the validity of prior results and report that stocks with higher idiosyncratic volatility (calculated on one month of daily data) have decidedly lower returns; while Malkiel and Xu (2006) respond that the Ang et al. findings may be due to an 'errors in variables' problem when fitting their model to the short data sample. Thus controversy surrounds even the direction of an idiosyncratic volatility effect for stock returns.

Company size is generally positively correlated with a stock's liquidity (Amihud, 2002). Liquidity therefore offers a potential explanation for the size effect. Consistently, in Australian markets, Beedles et al. (1988) have found that large firms have greater liquidity and suggest that liquidity partially explains the size effect. Amihud and Mendelson (1986) suggest that liquidity is an important attribute of a financial investment and should command a premium in asset pricing. O'Hara (2003) views the costs of liquidity as akin to a tax, which if large enough should negatively affect asset prices.

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. However, 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.

The inventory control models of Merton (1987) and Brunnermeier and Pedersen (2006) imply a negative relationship between liquidity and idiosyncratic volatility. By allowing both for liquidity and idiosyncratic volatility in their regression analysis, Malkiel and Xu (2006) provide evidence that idiosyncratic volatility subsumes the explanatory contribution of liquidity. Bali et al. (2005) suggest that the relation between idiosyncratic volatility and returns found by Goyal and Santa-Clara (2003) is in part driven by a liquidity premium. Spiegel and Wang (2005) show that idiosyncratic volatility and liquidity are inversely related and conclude that the relationship between idiosyncratic volatility and returns could be capturing both the relationship between liquidity and returns and the relationship between size and returns.

2. Data 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 2003, 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 and idiosyncratic volatility 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 \$27,000 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. Methodology. We rank stocks separately on beta, company size, liquidity and idiosyncratic volatility and create portfolios by partitioning the rankings into deciles. Having first observed the extent to which a sort of portfolios on one variable is actually a sort on the other variables, we examine the structure of returns for portfolios formed from the rankings on each of the four variables. Thereafter, we form six sets of 100 portfolios across pairs of the variables, which allow us to identify the pattern of returns on one variable while holding another variable constant. 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 say 10 portfolios before each such portfolio is sorted into say 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 created 10x10 sorts for each pair of variables by referencing each stock to each of its decile portfolios. For example, in constructing the 10x10 "idiosyncratic volatility – market capitalization" portfolios, a stock that appears in the decile 1 portfolio for the idiosyncratic volatility variable and decile 1 portfolio for the market capitalization variable appears in the percentile portfolio (1, 1), while a stock that appears in the decile portfolio 1 for the idiosyncratic volatility variable and decile 2 portfolio for the market capitalization variable appears in the percentile portfolio (1, 2), and so on. The variables (beta, firm size, liquidity, idiosyncratic volatility) are defined in the following subsections.

2.2.1. Stock beta (β_{it}). Beta ($\beta_{i,t}$) for each security i in each month t was calculated from the previous 60 months of historical data as:

$$\beta_{i,t} = \frac{Cov(r_{i,m}, r_{M,m})}{Var(r_{M,m})}, \tag{1}$$

where $r_{i,m}$ and $r_{M,m}$ are, respectively, the returns for security i and the market index M over months $m = t\text{-}59$ to month t. If a security did not trade for at least 35 of the previous 60 months, it was not included in month t's calculation.

2.2.2. Company size ($MC_{i,t}$). The market capitalization of stock i in 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.

2.2.3. Stock liquidity ($LIQ_{i,t}$). Liquidity for stock i in 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. A period of three months was chosen so as to be representative of the stock's liquidity over a reasonably sustained period.

2.2.4. Idiosyncratic volatility ($IV_{i,t}$). We consider a market pricing model at time t consistent with the CAPM as:

$$r_{i,t} = \alpha_i + \beta_{i,t}(r_{M,t}) + \varepsilon_{i,t}, \tag{2}$$

where $r_{i,t}$ is the excess return on stock i (over and above the risk-free rate) at time t, $\beta_{I,t}$ denotes asset i 's beta, $r_{M,t}$ denotes the excess return on the total market of assets, M, α_i denotes the constant or intercept term and $\varepsilon_{i,t}$ are the error terms. We estimate the (total) return variance for stock i at time t ($TV_{i,t}$ = variance of $r_{i,t}$) in terms of its market-explained variance (MV_t = variance of $r_{M,t}$) and idiosyncratic variance ($IV_{i,t}$ = variance of $\varepsilon_{i,t}$) components as:

$$TV_{i,t} = \beta_{i,t}^2 MV_t + IV_{i,t} \quad (3)$$

and hence estimate the idiosyncratic variance as:

$$IV_{i,t} = TV_{i,t} - \beta_{i,t}^2 MV_t . \quad (4)$$

The total volatility of asset i in month t ($TV_{i,t}$) was calculated in respect to monthly returns (m = t - 59 -> t) as:

$$TV_{i,t} = \frac{1}{\sum_{m=t-59}^{t} \lambda^{t-m}} \sum_{m=t-59}^{t} \lambda^{t-m} \left(r_{i,m} - \bar{r}_i\right)^2 , \quad (5)$$

where $\bar{r}_i$ is the mean return for company i over the 60-month period and λ is a damping factor. We assigned λ the value 0.8 somewhat arbitrarily with the outcome that returns realized more than three years prior to month t have relatively little weight. The outcomes of the analyses are not materially sensitive to the choice of λ.

3. Analysis of results

3.1. Single sort portfolios. Figures 1 through 4 plot the returns of portfolios constructed, respectively, on the variables of beta, market capitalization, stock liquidity and idiosyncratic return volatility. The relationships are plotted for equally-weighted (EW) and value-weighted (VW) returns over portfolio stocks. The corresponding tabulated values are presented as panels A-D of Table 1. Table 2 presents average values of beta, company size, liquidity and idiosyncratic volatility for each of the portfolios in Table 1.

Table 1. Average monthly returns of portfolios formed based on company size, stock beta, liquidity and idiosyncratic risk

Panel A. Portfolios formed based on beta (as Figure 1)										
	1	2	3	4	5	6	7	8	9	10
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%
Avg ß	-0.29	0.21	0.39	0.56	0.73	0.91	1.13	1.44	1.85	2.63
Panel B. Portfolios formed based on size (as Figure 2)										
	1	2	3	4	5	6	7	8	9	10
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%
Avg MC (m)	$1.94	$4.23	$7.25	$11.61	$18.04	$29.44	$52.29	$106.84	$284.77	$2,074.31
Panel C. Portfolios formed based on liquidity (as Figure 3)										
	1	2	3	4	5	6	7	8	9	10
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%
Avg LIQ	0.10%	0.32%	0.56%	0.83%	1.16%	1.57%	2.11%	2.90%	4.37%	9.56%
Panel D. Portfolios formed based on idiosyncratic risk (as Figure 4)										
	1	2	3	4	5	6	7	8	9	10
EW Return	0.86%	0.89%	0.91%	0.98%	1.20%	1.44%	1.57%	1.86%	2.63%	2.51%
VW Return	0.74%	0.68%	0.77%	0.30%	1.09%	0.49%	0.07%	-0.12%	0.07%	-0.63%
Avg IV	-0.27%	0.13%	0.33%	0.59%	0.94%	1.43%	2.14%	3.21%	5.21%	14.15%

Note: We calculate average monthly returns for portfolios formed based on company size (MC) and stock beta (β), liquidity (LIQ) and idiosyncratic volatility (IV) for the period 1980 through 2003. In each month t all stocks are ranked separately based on size, beta, liquidity and idiosyncratic volatility. 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 based on beta; decile 1 is for stocks with the lowest beta. Panel B reports returns for portfolios formed based on company size; decile 1 is for the smallest stocks. Panel C reports returns for portfolios formed based on liquidity; decile 1 is for the least liquid stocks. Panel D reports returns for portfolios formed based on idiosyncratic volatility; decile 1 is for stocks with the lowest idiosyncratic volatility.

Table 2. The relationship between beta, size, liquidity and idiosyncratic risk

Panel A. Portfolios formed based on beta (as Figure 1)				
Decile	Average ß	Average MC (m)	Average LIQ	Average IV
1 (low)	-0.29	$60	1.91%	4.31%
2	0.21	$145	1.49%	1.78%
3	0.39	$222	1.57%	1.58%
4	0.56	$366	1.73%	1.90%
5	0.73	$625	2.08%	2.08%
6	0.91	$670	2.29%	2.18%
7	1.13	$629	2.65%	2.94%
8	1.44	$375	3.25%	3.86%
9	1.85	$219	3.73%	4.73%
10 (High)	2.63	$69	4.63%	7.02%
Panel B. Portfolios formed based on company size (as Figure 2)				
Decile	Average MC (m)	Average ß	Average LIQ	Average IV
1 (Low)	$2	1.06	3.02%	6.85%
2	$4	1.10	3.25%	5.64%
3	$7	1.08	3.21%	4.95%
4	$12	1.01	2.94%	4.14%
5	$18	0.98	2.76%	3.55%
6	$29	0.92	2.41%	2.81%
7	$52	0.88	2.08%	2.36%
8	$107	0.90	1.89%	1.90%
9	$285	0.94	1.83%	1.03%
10 (High)	$2,074	0.96	2.15%	0.53%
Panel C. Portfolios formed based on liquidity (as Figure 3)				
Decile	Average LIQ	Average ß	Average MC (m)	Average IV
1 (Low)	0.10%	0.54	$324	0.10%
2	0.32%	0.60	$115	0.32%
3	0.56%	0.73	$138	0.56%
4	0.83%	0.82	$166	0.83%
5	1.16%	0.94	$244	1.16%
6	1.57%	1.02	$434	1.57%
7	2.11%	1.12	$584	2.11%
8	2.90%	1.24	$595	2.90%
9	4.37%	1.34	$527	4.37%
10 (High)	9.56%	1.45	$250	9.56%
Panel D. Portfolios formed based on idiosyncratic volatility (as Figure 4)				
Decile	Average IV	Average ß	Average MC (m)	Average LIQ
1 (Low)	0%	0.79	$1,040	1.38%
2	0.13%	0.63	$881	1.33%

Table 2 (cont.). The relationship between beta, size, liquidity and idiosyncratic risk

Decile	Average IV	Average ß	Average MC (m)	Average LIQ
3	0.33%	0.68	$550	1.44%
4	0.59%	0.75	$357	1.60%
5	0.94%	0.86	$219	1.87%
6	1.43%	0.97	$135	2.27%
7	2.14%	1.10	$82	2.71%
8	3.21%	1.20	$55	3.24%
9	5.21%	1.32	$37	3.97%
10 (High)	14.15%	1.46	$24	5.44%

Note: Portfolios are formed based on company size (MC) and stock beta (β), liquidity (LIQ) and idiosyncratic volatility (IV). The portfolios are rebalanced monthly and the average of the characteristics of MC, β, LIQ and IV for each portfolio is calculated as a time-series cross-sectional average. Panel A shows these averages for portfolios formed based on beta. Panel B shows these figures for portfolios formed based on size. Panel C shows these figures for portfolios formed based on liquidity. And panel D reports these figures for portfolios formed based on idiosyncratic volatility.

3.1.1. Beta (Figure 1). The graph of the relationship between return and beta (Figure 1) displays a number of interesting features. The equally-weighted returns on portfolios 3-9 display a roughly increasing relationship with beta. The returns calculated on a value-weighted average across portfolio stocks are uniformly lower than their equally-weighted counterparts. A higher (lower) return for the equally-weighted averaging compared with a value-weighted averaging indicates, by construction, that the explanatory variable being considered is acting more (less) positively in relation to returns for smaller companies within the portfolio.

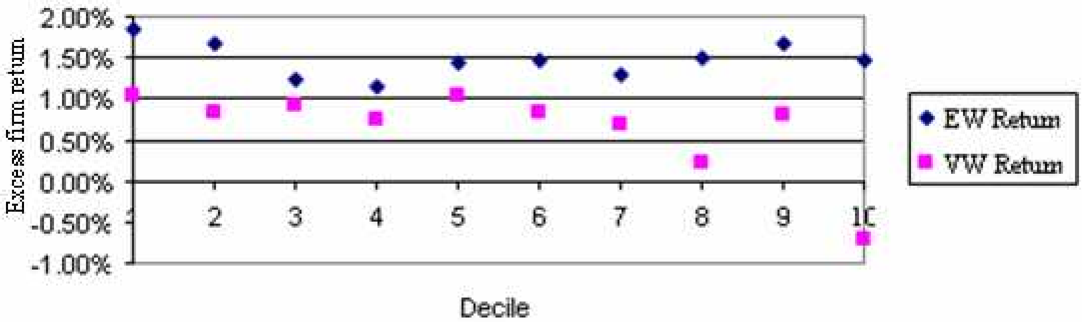

Fig. 1. Return and historical beta

Panel A of Table 2 reveals that the stocks in low-beta portfolio 1 (and to a lesser extent in portfolio 2) have negative betas. We note from Panel A of Table 2 that portfolios formed on increasing beta are monotonically increasing in liquidity for portfolios 2-10 and in idiosyncratic volatility for portfolios 3-10, while portfolios 1-7 are monotonic in market capitalization, with the relationship reversed for portfolios 8-10. Both portfolios 1 and 10 are characterized by low market capitalization, high idiosyncratic volatility and moderate-to-high liquidity.

Noteworthy is the overall irregular trend for both equally-weighted and value-weighted portfolio returns in Figure 1. In particular, we note the high equally-weighted portfolio returns for low beta portfolios and the sharp and irregular decline in value-weighted portfolio returns (Figure 1 and Panel A of Table 1). One possibility here is that for the lowest and highest beta portfolios, the usual direction of causality from beta to return is reversed. Thus stocks of smaller companies that have gone against the market by performing unexpectedly well during market declines (resource stocks, for example) have positive returns and, therefore, negative betas. Similarly, that when stocks of large companies unexpectedly pull the market down (the banking sector, as has been the case, for example), such stocks have negative returns and highly positive betas. It is salutary for researchers to be aware of such possible reversals of causality direction in their data. For example, when we apply a linear regression to the equally-weighted portfolio returns on beta in Figure 1, we find, not surprisingly, that there is no statistically significant correlation between returns and beta – thereby missing the roughly increasing trend of returns with betas for portfolios 3-9. Similarly, for example, Faff (2001a) has applied a linear regression to the Australian data and reported that beta has no effect on stock returns.

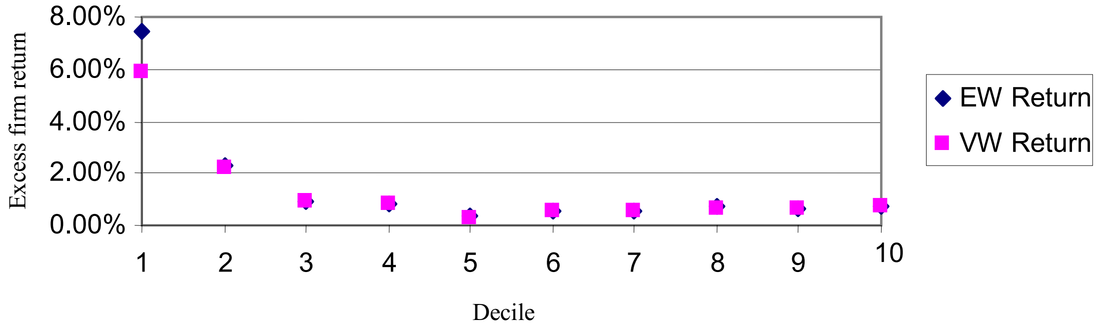

Fig. 2. Return and capitalization

3.1.2. Company size (Figure 2). Turning to the relationship between portfolio returns and market capitalization shown in Figure 2 (equally-weighted and value-weighted returns are essentially identical for portfolios 2-10), we observe that the relationship is declining with market capitalization. Thus the graph appears to be broadly consistent with the relationship that Spiegel and Wang (2005) report for non-Australian stocks. We note, however, that this inverse relationship holds only for corporations with quite low market capitalizations. We also note that Chan and Faff (2003) report a *flat* regression relationship between returns and market capitalization for Australian stocks. It is possible, therefore, that stocks driving the return performance of our portfolios 1 and 2 have been suppressed in Chan and Faff's linear regression analysis. Our findings are consistent with Banz (1981) for the US and Gaunt (2004), Brown et al. (1983) and Beedles et al. (1988) for Australia, who find that the size effect holds only for their smallest stocks.

3.1.3. Liquidity (Figure 3). As Figure 3 shows, the relationship between portfolio return and liquidity is rather flat. The literature generally (Chan and Faff (2003) for Australian data) reports a *negative* relationship between stock returns and the liquidity measure used here. We observe that the stocks with the smallest market capitalization (portfolios 1 and 2) that give the high returns in our analysis (Figure 2) are those with the highest turnover and hence highest liquidity (Panel B of Table 2). So it is again possible to hypothesize how the direction of causality might reverse itself: small stocks tend to trade more frequently as they increase in value. In other words, such stocks might have high liquidities *because* they are performing well, rather than that their returns are an outcome of their high liquidities. It is therefore possible to speculate that such directions of causality between the variables are confounding each another in the flat relationship observed in Figure 3. Nonetheless, our findings are consistent with Anderson, Clarkson, and Moran (1997) who fail to find a strong relationship between liquidity and size in the Australian market.

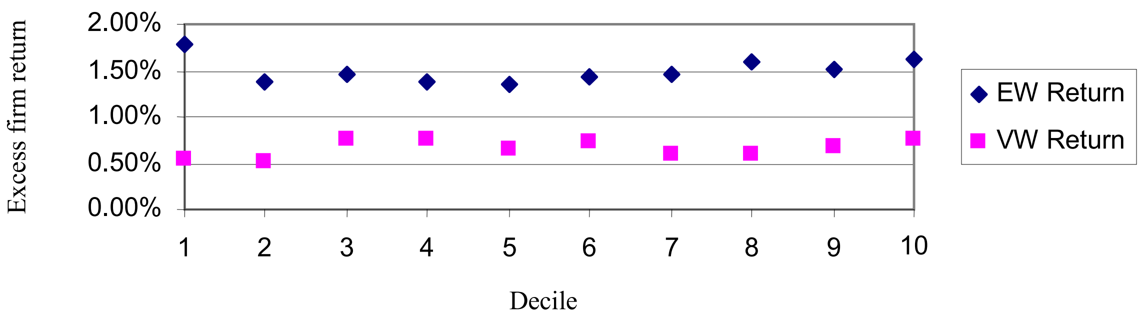

Fig. 3. Return and liquidity (Share turnover)

3.1.4. Idiosyncratic volatility (Figure 4). Figure 4 displays the relationship between portfolio returns and idiosyncratic volatility. The relationships between both equally-weighted and value-weighted returns contradict each other. The equally-weighted returns are monotonically increasing (with the exception of portfolio 10) which is consistent with the findings of Malkiel and Xu (1997). The downward direction of the value-weighted portfolio returns from portfolio 4 onwards is precipitous. Clearly, larger capitalized stocks with higher idiosyncratic volatility are somehow associated with *declining* returns. One implication is that increases in volatility for stocks of larger companies indicate apprehension and auger declines. And so it is again possible to hypothesize both causal directions: investors require higher returns for taking on higher idiosyncratic volatility, and higher levels of idiosyncratic volatility of large firms presage declining prices and lower returns.

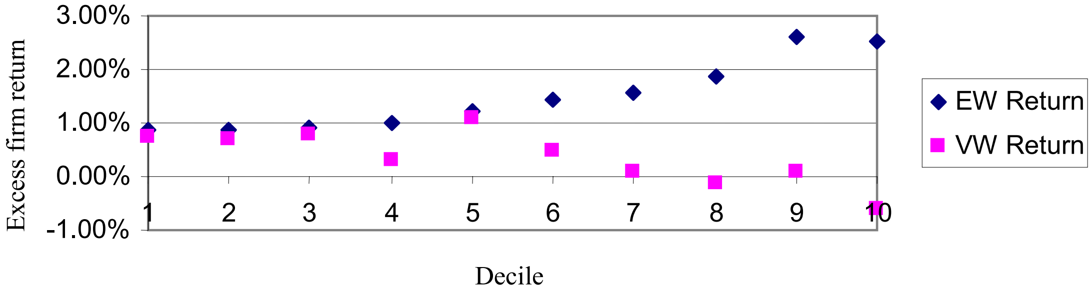

Fig. 4. Return and idiosyncratic volatility

3.2. Double sort portfolios. Pairwise sorts of variables allow the explanatory power of one variable to be examined while controlling for the explanatory power of a second variable. With four variables (beta, company size, liquidity and idiosyncratic volatility) we have six pairwise sorts for which we calculated equally-weighted returns averaged over a portfolio's stocks for the sample period. Figures 5-10 present three-dimensional graphs of our results, and panels A-F of Table 3 summarize the tabulated values. The essential observed trends are summarized as follows.

Table 3. Average monthly returns of portfolios formed by two-dimensional sorts on beta, size, liquidity and idiosyncratic risk

Panel A. Beta and size (as Figure 5)										
	ß1	2	3	4	5	6	7	8	9	ß10
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%
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%
Panel B. Beta and liquidity (as Figure 6)										
	ß1	2	3	4	5	6	7	8	9	ß10
LIQ 1	1.84%	0.92%	1.16%	1.26%	0.63%	2.15%	1.33%	2.12%	3.10%	5.16%
2	2.02%	1.11%	1.26%	1.04%	2.09%	1.68%	1.06%	0.03%	2.03%	2.15%
3	2.22%	0.82%	0.99%	0.51%	1.03%	1.39%	1.74%	2.37%	1.09%	2.46%
4	2.45%	1.87%	1.09%	1.16%	1.49%	0.74%	1.69%	2.17%	3.17%	2.11%
5	2.59%	2.41%	1.04%	1.24%	1.20%	1.20%	1.45%	0.17%	1.21%	1.53%
6	1.24%	1.57%	1.31%	1.10%	1.34%	1.27%	1.52%	1.92%	1.86%	2.16%
7	2.77%	2.31%	1.22%	1.63%	1.69%	1.19%	1.29%	1.82%	2.11%	1.79%
8	3.22%	1.54%	1.86%	1.43%	1.75%	0.84%	0.95%	1.21%	0.06%	1.73%
9	2.95%	2.35%	3.00%	1.70%	1.18%	0.42%	2.88%	1.14%	2.13%	2.02%
LIQ 10	0.75%	2.50%	1.14%	1.64%	2.79%	0.86%	1.38%	0.53%	1.78%	1.70%
Panel C. Size and liquidity (as Figure 7)										
	MC 1	2	3	4	5	6	7	8	9	MC10
LIQ 1	7.70%	1.92%	0.93%	-0.02%	1.51%	0.23%	0.49%	0.39%	0.52%	0.51%
2	7.51%	1.33%	0.44%	0.12%	0.63%	0.53%	0.60%	0.62%	0.81%	0.01%

Table 3 (cont.). Average monthly returns of portfolios formed by two-dimensional sorts on beta, size, liquidity and idiosyncratic risk

	MC 1	2	3	4	5	6	7	8	9	MC10
3	6.64%	0.95%	1.79%	-0.32%	-0.02%	0.33%	0.71%	0.68%	0.74%	0.44%
4	8.96%	1.47%	0.91%	1.05%	0.59%	0.45%	0.78%	0.42%	1.02%	0.54%
5	6.88%	2.06%	0.81%	0.55%	0.41%	0.65%	0.95%	0.54%	0.45%	0.50%
6	9.22%	2.67%	0.35%	-0.26%	0.19%	0.72%	0.44%	1.00%	0.38%	1.14%
7	9.33%	3.43%	1.59%	0.77%	0.21%	0.59%	0.27%	0.54%	0.71%	0.80%
8	7.80%	2.95%	0.54%	0.17%	0.54%	-0.81%	0.91%	0.61%	0.41%	0.61%
9	8.93%	4.52%	1.22%	1.29%	1.44%	-0.01%	0.68%	-0.61%	1.42%	0.15%
LIQ 10	8.11%	4.34%	0.97%	1.10%	0.00%	-0.53%	-0.53%	-0.43%	-0.03%	0.15%
Panel D. Beta and idiosyncratic volatility (as Figure 8)										
	ß1	2	3	4	5	6	7	8	9	ß10
IV 1	1.33%	0.91%	0.48%	0.18%	-0.30%	-0.79%	-1.92%	-2.78%	-5.59%	-3.04%
2	1.26%	0.98%	0.85%	1.10%	0.96%	1.08%	1.04%	0.76%	0.15%	-1.88%
3	1.45%	1.11%	1.39%	1.25%	0.95%	0.94%	1.15%	0.50%	1.14%	0.97%
4	1.02%	1.23%	1.02%	1.12%	1.09%	0.98%	1.24%	0.90%	0.64%	1.05%
5	1.38%	1.36%	1.35%	1.29%	1.28%	1.64%	0.84%	0.60%	0.71%	2.04%
6	1.83%	0.79%	0.67%	1.30%	1.61%	-0.04%	1.61%	1.16%	2.05%	2.09%
7	2.33%	0.74%	1.00%	1.85%	1.81%	2.08%	1.65%	0.85%	1.43%	1.89%
8	2.05%	2.40%	2.68%	1.42%	3.64%	0.94%	1.95%	2.53%	2.23%	2.92%
9	3.84%	5.15%	3.47%	0.48%	2.88%	2.50%	1.83%	3.07%	2.95%	2.75%
IV 10	4.31%	4.99%	3.52%	3.43%	3.65%	2.67%	5.02%	1.92%	3.45%	2.79%
Panel E. Liquidity and idiosyncratic volatility (as Figure 9)										
	LIQ 1	2	3	4	5	6	7	8	9	LIQ 10
IV 1	0.88%	0.23%	0.22%	0.07%	-0.34%	-0.29%	-0.75%	-1.48%	-3.34%	-9.30%
2	1.11%	0.69%	1.13%	0.80%	0.97%	0.93%	1.27%	0.92%	0.72%	0.47%
3	1.27%	1.11%	1.01%	1.24%	1.24%	1.25%	1.39%	1.07%	0.56%	0.64%
4	0.96%	0.86%	0.90%	1.04%	1.09%	0.99%	1.70%	1.18%	0.92%	1.13%
5	0.74%	1.63%	1.95%	0.81%	0.50%	1.35%	1.11%	1.10%	2.12%	1.04%
6	1.01%	0.69%	0.88%	1.23%	0.94%	1.65%	1.68%	0.52%	2.63%	1.94%
7	1.05%	0.64%	0.92%	1.94%	2.13%	1.39%	2.41%	1.50%	1.83%	1.46%
8	0.46%	2.51%	0.62%	3.03%	2.91%	2.54%	1.74%	2.50%	3.31%	2.19%
9	3.50%	4.26%	3.11%	4.46%	2.00%	3.46%	2.44%	2.33%	2.50%	2.26%
IV 10	6.58%	4.93%	4.12%	5.05%	3.50%	3.20%	5.44%	3.07%	3.42%	1.57%
Panel F. Size and idiosyncratic volatility (as Figure 10)										
	MC 1	2	3	4	5	6	7	8	9	MC 10
IV 1	2.29%	-1.80%	-2.50%	-1.97%	-1.18%	-1.73%	-0.79%	-0.64%	-0.22%	-0.17%
2	1.85%	0.50%	1.79%	0.88%	0.93%	0.73%	1.02%	0.84%	1.01%	0.94%
3	3.23%	1.92%	1.38%	0.87%	0.86%	1.43%	0.98%	1.18%	1.14%	0.78%
4	2.72%	1.25%	1.98%	0.82%	1.30%	0.91%	1.01%	1.08%	0.84%	0.46%
5	3.85%	2.58%	1.05%	1.01%	1.02%	0.58%	1.12%	0.80%	1.16%	1.04%
6	5.08%	2.56%	0.98%	0.56%	0.85%	-0.06%	1.47%	0.53%	1.03%	1.55%
7	6.40%	2.90%	0.76%	0.24%	0.48%	0.58%	0.27%	0.30%	1.04%	1.14%
8	7.42%	3.38%	1.39%	0.68%	0.55%	-0.29%	0.13%	1.77%	0.94%	0.98%

Table 3 (cont.). Average monthly returns of portfolios formed by two-dimensional sorts on beta, size, liquidity and idiosyncratic risk

	MC 1	2	3	4	5	6	7	8	9	MC 10
9	9.42%	3.26%	1.06%	-0.31%	0.36%	-0.24%	0.59%	-1.05%	-1.54%	1.07%
IV 10	11.29%	2.87%	0.32%	0.90%	-0.44%	-1.00%	-2.11%	-3.41%	-3.15%	-4.14%

Note: We calculate average monthly returns for portfolios formed based on pairs of factors (beta (β), size (MC), liquidity (LIQ) and idiosyncratic volatility (IV)) for the period 1980 through 2003. In each month *t* each stock is ranked separately on the four variables (β, MC, LIQ and IV) and allocated to a decile portfolio (1-10 as in Tables 1-4) according to its ranking on each of the four variables. Thus, each stock is allocated to four portfolios (1-10). Portfolios 1-100 are then formed based on variable pairs according to the cross rankings of their allocations to portfolios 1-10. For example, for beta and size, a stock from portfolio 1 of lowest betas and from portfolio 1 of lowest market capitalization is assigned to portfolio (1, 1), a stock from portfolio 1 of lowest betas and from portfolio 2 of 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. Panel A is for portfolios formed based on beta and size. Panel B is for portfolios formed based on beta and liquidity. Panel C is for portfolios formed based on size and liquidity. Panel D is for portfolios formed based on beta and idiosyncratic volatility. Panel E is for portfolios formed based on liquidity and idiosyncratic volatility. Panel F is for portfolios formed based on size and idiosyncratic volatility.

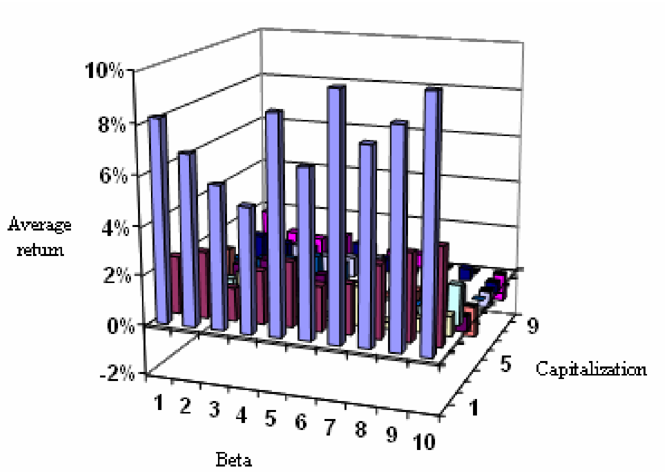

Fig. 5. Beta and capitalization

3.2.1. Beta and company size (Figure 5). Figure 5 confirms that very small companies are associated with dramatically higher returns (as Figure 2 above). Here, the explanatory power of beta is not strong and may be negatively correlated with the decile returns, with the exception of the deciles of the smallest companies, across which we have a somewhat U-shape (as in Figure 1). The flattish linear regressions applied across each decile of market capitalization accord with the proposition of Fama and French that controlling for market capitalization reveals little if any explanatory power for beta-based regressions.

3.2.2. Beta and liquidity (Figure 6). In Figure 6, returns exhibit a mild U-shape dependence on beta. In general, however, beta and liquidity display little explanatory power for stock returns.

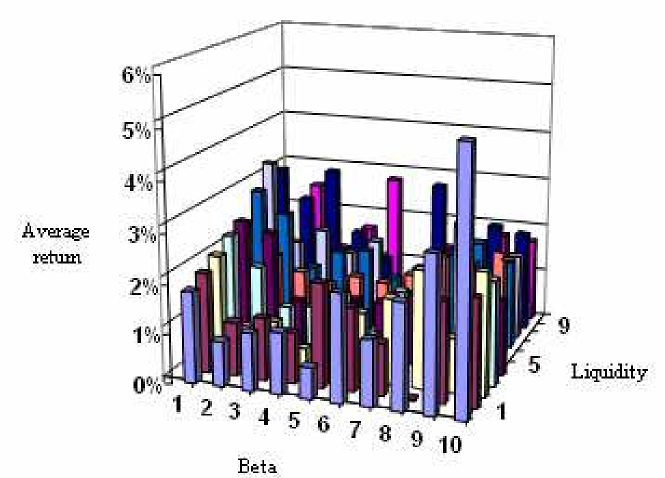

Fig. 6. Beta and liquidity

3.2.3. Company size and liquidity (Figure 7). Figure 7 displays a dramatic inverse correlation of market capitalization with returns, which accords with Figures 2 and 5. The Figure reveals that the relationship between a company's liquidity and its returns is virtually flat, consistent with Figure 3 and also with Anderson et al. (1997).

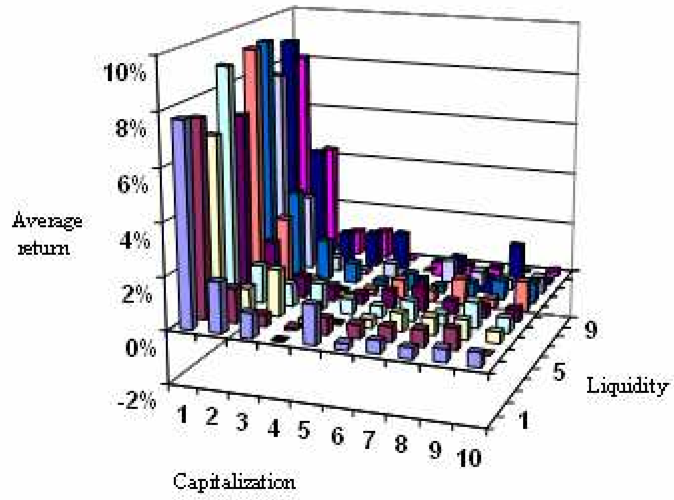

Fig. 7. Capitalization and liquidity

3.2.4. Idiosyncratic volatility and beta (Figure 8). Figure 8 shows that idiosyncratic volatility has a much greater impact on returns than beta. Controlling for beta, portfolios of stocks with higher idiosyncratic volatility have higher returns; while controlling for idiosyncratic volatility, portfolios of stocks with higher beta have slightly lower returns. Most notable is the dramatic pattern in increase of returns as we move diagonally from portfolios formed on low idiosyncratic volatility and high beta (which have negative returns) to portfolios based on high idiosyncratic volatility and low beta. An explanation is as follows. At the high end of idiosyncratic volatility, we are seeing high returns consistent with Figure 4. At the low end of idiosyncratic volatility, we mostly have stocks of large corporations (Panel D of Table 2). So, here, we are consistent with Figure 1, where we have attributed the highly negative value-weighted returns for the highest beta decile portfolio to stocks of large corporations.

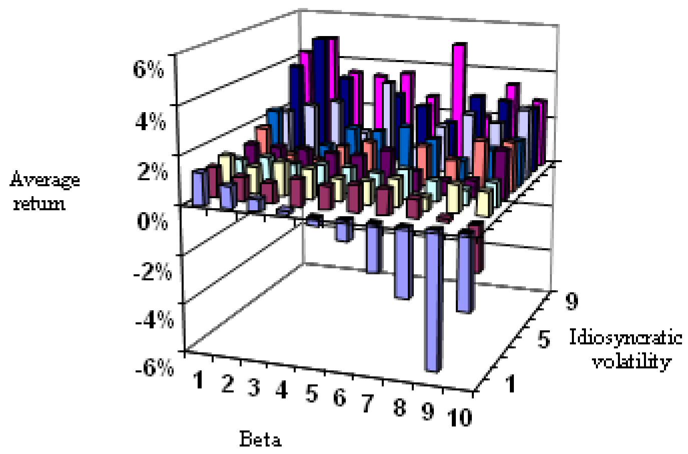

Fig. 8. Beta and idiosyncratic volatility

3.2.5. Idiosyncratic volatility and liquidity (Figure 9). Figure 9 illustrates that a stock's idiosyncratic volatility has a greater impact on earnings than a company's liquidity. The patterns are similar to those of Figure 8, but liquidity replaces beta. Thus, controlling for liquidity, portfolios of stocks with higher idiosyncratic volatility display higher returns; controlling for idiosyncratic volatility, portfolios of stocks with higher liquidity display somewhat lower returns. Again, it is notable that portfolio returns improve dramatically as we move from portfolios formed on low idiosyncratic volatility and high liquidity (which have negative returns) to portfolios formed based on high idiosyncratic volatility and low liquidity. So far as beta and liquidity appear to be highly correlated (Panels A and C of Table 2) it may be that we are seeing the same pattern of outcomes simply repeated in both Figures 8 and 9. Additionally, we note that low liquidities are associated with low idiosyncratic volatility (Panels C and D of Table 2) implying that the average negative return in the low idiosyncratic volatility – high liquidity corner in Figure 9 is the outcome of a relatively small number of observations of stocks.

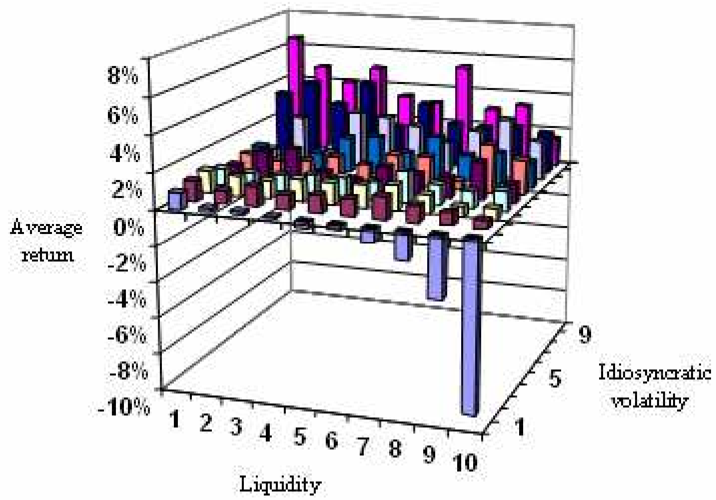

Fig. 9. Liquidity and idiosyncratic volatility

3.2.6. Idiosyncratic volatility and company size (Figure 10). Figure 10 again shows the superior performances of low-capitalized stocks (as Figures 2, 5 and 7). The graph reveals a clear relationship between returns and idiosyncratic volatility for stocks of small companies that is consistent with the trend of equally weighted portfolios in Figure 4. In a similar vein, Brown and Ferreira (2004) have argued that the idiosyncratic volatilities of small companies are significantly positive predictors of stock returns; while Angelidis and Tessaromatis (2005) find evidence that the idiosyncratic volatility of stocks of small firm size is associated with the small capitalization premium.

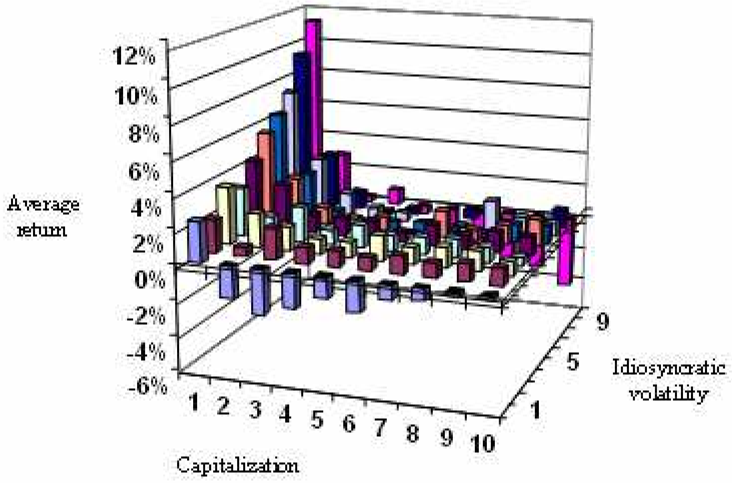

Fig. 10. Capitalization and idiosyncratic volatility

Bali et al. (2005) have contended that the finding of Goyal and Santa-Clara (2003) showing a relationship between market returns and prior month levels of idiosyncratic volatility is driven largely by stocks of small companies. We note that the largest companies with high idiosyncratic volatility in Figure 10 (portfolio (10,10)) have marked negative returns (which is consistent with Figure 4 where value-weighted portfolio returns decrease with idiosyncratic volatility). Thus we have additional confirmation that although idiosyncratic volatility dominates over both beta and liquidity (Figures 8 and 9), idiosyncratic volatility only adds significant explanatory power in relation to market capitalization for very small market capitalized companies.

Conclusion

Consistent with Fama and French (1992), we find that although the returns for Australian stocks with higher beta generally exceed those of lower (but still positive) betas, the explanatory power of beta largely disappears when we control for firm capitalization. Our findings are also consistent with Fama and French (1996) in that we document that smaller companies have returns markedly higher than larger companies. Conflicting with Fama and

French's findings, however, the capitalization (size) effect in our data is evident only for stocks that fall below a certain size threshold. For companies smaller than the threshold size, the association of increasing returns with decreasing company size is dramatic; for companies larger than the threshold, however, we find no evidence of the size effect. These findings are roughly consistent with previous Australian findings (by Gaunt, 2004; Brown et al., 1983 and Beedles et al., 1988).

Our findings are also consistent with Malkiel and Xu (1997, 2006). We find that a stock's capitalization is highly negatively correlated with its idiosyncratic volatility (as Malkiel and Xu, 1997) and that a stock's idiosyncratic volatility is a stronger determinant of returns than beta (as Malkiel and Xu, 2006). The strong correlation between idiosyncratic volatility and returns in our data, however, exists mainly for smaller companies below a certain level of capitalization.

Unlike Datar, Naik and Radcliffe (1998) in the US and Chan and Faff (2003) in Australia who find that liquidity has a definite negative relationship with returns, we find no such relationship. Amihud (2002), however, finds that while expected market liquidity has a negative relation with stock returns, unexpected liquidity has a positive correlation. Thus it is possible that the explanation for our disparity with Chan and Faff lies in our extended sample of small companies for which stocks with a higher return performance are associated with an increased trading volume and hence liquidity. Our findings are nevertheless consistent with Malkiel and Xu (2006) and Spiegel and Wang (2005) for US equities who find that idiosyncratic risk dominates liquidity as an explanation of stock returns,

We have hypothesized that several anomalies in our findings are the outcomes of causality reversal between returns and the considered explanatory variables. First, it appears that Australian equities include a significant number of stocks of small companies that have continued to perform well in otherwise declining markets; they consequently have quite high returns and low (or even negative) betas. Second, it appears that stocks of large companies have on occasion led the market downward; consequently, such stocks have low returns and high betas. As a result of this second effect, the value-weighted returns for portfolios can be decreasing with increasing beta while the equally-valued returns for the same portfolios are increasing. Third, we have hypothesized that increases in the stock volatility of large companies may presage declines in their stock value. As a result, value-weighted returns may be decreasing with idiosyncratic volatility while equally-valued returns are increasing.

We conclude by summarizing our main conclusions as follows. We do not find evidence of a systematic relationship between beta and returns independent of a company's size. Our overwhelming evidence is that portfolios of stocks of very small companies outperform the market, while, additionally, stocks with higher idiosyncratic volatility within such portfolios significantly outperform stocks with lower idiosyncratic volatility. The significance of our paper is that we do not have substantive evidence to support the notion that stock returns in Australian markets are the outcome of investors who set prices in accordance with a regard for any of the variables that we have considered.

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