Are Beta, Firm Size, Liquidity and Idiosyncratic Volatility related to Stock Returns? Australian Evidence

Louise Clayton [a], Michael Dempsey [b*] and Madhu Veeraraghavan [c]

[a,b] Department of Accounting and Finance, Monash University, Caulfield Campus, Victoria, Melbourne, Australia.

[c] Department of Accounting and Finance, Monash University, Clayton Campus, Victoria 3800, Melbourne, Australia and Centre Associate, Melbourne Centre for Financial Studies, Melbourne, Australia.

Address for Correspondence:
Mike Dempsey
Department of Accounting and Finance
Faculty of Business and Economics
PO Box 197
Monash University
VIC 3145 Australia
Tel: 61 3 9903 4543
Fax: 61 3 9905 5475
Email: Michael.Dempsey@BusEco.monash.edu.au

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We are indebted to Bernie Bollen for kind assistance in the programming of the data analysis. We are indebted also to Robert Faff for helpful comments and discussions. Dempsey and Veeraraghavan gratefully acknowledge financial support from the Melbourne Centre for Financial Studies (Cost Centre B07005 and 1779270). Any errors are our own.

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Abstract

The paper is aimed at examining the inter-relationships between firm size, liquidity, idiosyncratic volatility and their relation to a stock's beta and return performance for Australian equities. Our analysis suggests the existence of confounding effects that may need to be recognised in making meaningful interpretations of the data; specifically, that as well as being potentially *explanatory* of equity performance, beta, liquidity and idiosyncratic volatility are capable of being the *outcome* of equity performance behaviour. Over and above achieving a degree of clarification on these issues, the paper's main conclusions are summarised as follows. We find no relationship between beta, firm size, liquidity or idiosyncratic volatility and stock returns for large stocks. However, the smallest capitalised stocks markedly outperform the largest capitalised stocks, and for such small capitalised stocks those with greater idiosyncratic volatility have markedly superior returns.

JEL Classification: G10, G12, G15

Key Words: Multifactor Model, Beta, Idiosyncratic Volatility, Size Effect, Liquidity

I. 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 the product of that risky asset's beta (the covariance or its returns with market returns) with 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 capitalisation 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; while Fama and French (1992) show that beta and firm capitalisation are highly correlated.

The Fama and French (1993) three-factor model incorporating firm capitalisation and book-to-market ratio alongside firm beta is now widely applied. 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 minimised by less frequent trading and 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.

In separating the influences of the variables: market capitalisation, stock liquidity and idiosyncratic volatility in the context of US markets, Spiegel and Wang (2005) find that high idiosyncratic volatility firms tend both to small capitalisation and to low levels of liquidity, and that stock returns are increasing with the level of idiosyncratic volatility (and decreasing in a stock's capitalisation 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 stock returns subsumes the relationships of both capitalisation and liquidity with returns.

The degree to which beta, capitalisation, liquidity and idiosyncratic volatility may be a proxy for one or more of the other variables remains controversial. So also does the extent to which any one of these variables might be capturing an element of investor risk exposure (either diversifiable or non-diversifiable). In effect, no convincing theory has been advanced to explain the contribution of these variables.

In this paper, we follow an approach similar to that of Spiegel and Wang, for Australian equities over the period 1980-2003. Our analysis suggests the existence of confounding effects that may need to be recognised in making meaningful interpretations of the data – and which do not appear to have been fully recognised in the context of Australian markets. More specifically, we conclude that as well as being *explanatory* of equity performance, beta, liquidity and idiosyncratic risk are capable of being the *outcome* of equity performance behaviour. Thus, it appears that a causal relationship between a given variable and returns in one direction can be re-enforced (or confounded) in the data by a reciprocal causal relationship between returns and the same variable that acts to re-enforce (or confound) the relationship. To see what is implied here, consider that investors require higher returns for holding higher beta stocks (one direction of causality) but that superior performing stocks in positive markets thereby generate higher measures of beta on the data (the opposite direction of causality), in which case the two effects should be reinforcing in the data. Or, alternatively, consider that investors require lower returns for holding higher liquidity stocks, but that stocks generating higher returns tend to be more highly liquid, in which case the two directions of causality will tend to be confounding in the data. As well as achieving a degree of clarification on these issues, the paper's main conclusions are summarised as follows. There appears to be no general tendency for beta, firm size, liquidity or idiosyncratic volatility, to influence the overall observed pattern of larger capitalised Australian stock returns. However, the smallest capitalised stocks markedly outperform the largest capitalised stocks, and for such small capitalised stocks those with greater idiosyncratic volatility have markedly superior returns.

The rest of the paper is arranged as follows. Section II presents prior literature while Section III describes the data and the methodology employed in this paper. In section IV we discuss the results and section V concludes.

II. 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) study and find the magnitude and statistical significance of the parameters to be generally comparable to those reported by Fama and French (1993). 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 3-factor model, a consideration of a firm's market capitalisation or 'size effect' has become almost conventional. Nevertheless, the evidence is not always one way. 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. Brown, Kliedon, Keim and Marsh (1983) provide out of sample evidence of the small firm effect in the Australia market. They 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 time interval studied.

Consistent with the US findings of Banz, their relationship between firm size and returns is located in the smallest stocks. Beedles, Dodd and Officer (1988) also find that the size effect is prevalent in Australia and is robust to several methodological adjustments. They find evidence that transaction costs can explain a part of the size anomaly but that this does not appear to be the dominant factor. Notwithstanding, Chan and Faff (2003) report a flat regression relationship between returns and firm size for Australian stocks for the period 1990-1999, while Gaunt (2004) find no clear evidence of the small firm size effect either way in Australian markets .

Malkiel and Xu (1997) show a high negative correlation between firm size and idiosyncratic volatility and suggest that idiosyncratic risk might be the explanation of the size effect. They consider that idiosyncratic risk is rationally priced if portfolio managers have to 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 voluntary or non-voluntary) are incompletely diversified. Similar to the approach adopted here, Malkiel and Xu (1997) divide stocks into portfolios based on their idiosyncratic volatility and report the average annual return of these portfolios over the period 1963-1994. The results show a clear trend for higher idiosyncratic risk portfolios to generate higher returns. However, in contrast, Ang, Hodrick, Xing and Zhang (2006) report that higher idiosyncratic volatility stocks have decidedly lower returns. They argue that their contradiction of prior studies is due to such studies not examining idiosyncratic volatility at the firm level. Malkiel and Xu (2006) however argue that the Ang et al. result may be due to an 'errors in variables' problem when fitting their model to the short sample of data.

Firm size is generally positively correlated with a stock's liquidity (Amihud, 2002). Thus, liquidity offers a potential explanation for the size effect. Consistently, in Australian markets, Beedles et al. (1988) have found that large firms have higher 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) has viewed 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) using share turnover as a proxy for liquidity 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. Malkiel and Xu (2006) by allowing both for liquidity and idiosyncratic volatility in their regression analysis 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) sort stocks by idiosyncratic volatility and find this produces the same sort on liquidity, implying that high idiosyncratic volatility stocks have low liquidity. They conclude that the relationship between idiosyncratic volatility and returns could be capturing both the relationships between liquidity and returns and size and returns.

III. Data and Methodology

A. Data

We obtained the data for this study from two sources. The Monthly MONFBDS Australian equities database derived from the AGSM database was used to calculate beta and idiosyncratic volatility. The SIRCA database which runs from 1980 through 2003 with daily returns and daily trading volume for Australian equities was matched with the AGSM database. The SIRCA data was used to calculate liquidity.

In order to be included in the sample for a given month, a stock is required to be traded in 35 out of the previous 60 months (to calculate both the beta and idiosyncratic volatility for the stock for that month) and have traded in that month and the previous two months (to calculate liquidity). Our final sample had a total of 190,218 monthly observations with a range of firm size from $27,000 to $46 billion (with an average capitalisation size of approximately $400 million as compared with the average capitalisation size of the original total sample closer to $350 million). In any month, the number of firms ranged from just under 200 to over 1,000. In all, 2,347 firms contributed. In the two-dimensional sorts, the minimum number of observations assigned to any portfolio was 270.

B. Methodology

We rank stocks separately on beta, firm size, liquidity and idiosyncratic volatility and create portfolios by partitioning the rankings into deciles. Firstly, we observe the extent to which a sort of portfolios on one variable is actually a sort on the other variables. Secondly, we examine the structure of returns across the four sets of ten portfolios formed on the ranking of each of the four variables.

Thirdly, 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 in effect 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 imposition that each portfolio necessarily 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 10 x 10 "idiosyncratic volatility – market capitalisation" portfolios, a stock that appears in the decile 1 portfolio for the idiosyncratic volatility variable and portfolio 1 for the market capitalisation variable appears in portfolio (1, 1), while a stock that appears in portfolio 1 for the idiosyncratic volatility variable and portfolio 2 for the market capitalisation variable appears in the percentile portfolio (1, 2), and so on. The variables (beta, firm size, liquidity, idiosyncratic volatility) are defined as follows.

B.1 Beta ($\beta_{i,t}$)

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

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

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

B.2 Firm Size (MC $_{i,t}$)

The market capitalisation of stock *i* in month *t* (MC $_{i,t}$) is measured as the number of firm *i*'s shares outstanding times the share price at the end of the month (*t*).

B.3 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*.

B.4 Idiosyncratic Volatility (IV$_{i,t}$)

We consider a market pricing model at time *t* consistent with the CAPM as:

$$r_{i,m} = \alpha_i + \beta_i\left(r_{M,m}\right) + \varepsilon_{i,m} \tag{2}$$

where $r_{i,t}$ is the excess return on stock *i* 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. Hence 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 $r_{M.t-1}$) and idiosyncratic variance ($IV_{i,t}$ = variance of $\varepsilon_{i,t}$) components as:

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

and hence estimate the idiosyncratic variance as:

$$IV_{i,t} = TV_{i,t} - \beta_{i,t}^2 MV_t \tag{4}$$

which may be expressed:

$$IV_{i,t} = TV_{i,t}(1 - \rho_{i,t}^2) \tag{5}$$

where $\rho_{i,t}$ is the correlation coefficient between $r_{i,m}$ and r_M. The correlation coefficient $\rho_{i,t}$ was calculated as for $\beta_{i,t}$. The total volatility of asset *i* in month *t* ($TV_{i,t}$) was calculated in respect to monthly returns (*m* = *t*-59 -> *t*) with a higher weighting attributed to more recent monthly returns as:

$$TV_{i,t} = \frac{1}{\sum_{m=t-59}^{t} \lambda^{t-m}} \sum_{m=t-59}^{t} \lambda^{t-m} \left(r_{i,m} - \bar{r}_i\right)^2 \tag{6}$$

Where $\bar{r}_i$ is the mean return for firm *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 realised more than 3 years prior to month *t* have relatively little weight. The outcomes of the analyses are not materially sensitive to the choice of λ.

IV. Analysis of Results

A. Single Sort Portfolios

Figures 1 through 4 plot the relationship between average portfolio returns constructed, respectively, on beta, firm size, liquidity and idiosyncratic volatility. The relationships are plotted for equally-weighted and value-weighted returns over portfolio stocks. The corresponding tabulated values are presented as panels A–D of Table 1. Table 2 presents average values of beta, firm size, liquidity and idiosyncratic volatility for each of the portfolios in Table 1.

A.1 Beta (Figure 1)

The graph of return on beta (Figure 1) displays a number of interesting features. We note that the low-beta stocks in portfolio 1 (and to a lesser extent in portfolio 2) are actually negative, and that the equally-weighted returns on portfolios 3-9 display a linear 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 firms within the portfolio.

Panel A of Table 2 reveals that portfolios 2 through 10 formed on beta are monotonic in relation to both liquidity and idiosyncratic volatility, while portfolios 1 through 7 are monotonic in market capitalisation, with the relationship reversed for portfolios 8 through 10. Both portfolios 1 and 10 are characterised as having low market capitalisation, high idiosyncratic volatility, and moderate to high liquidity. Most remarkable, however, is the sharp decline in value-weighted portfolio returns for portfolios 8-10. These features of the graph call for consideration.

It is possible to hypothesise that for portfolios 1, 9 and 10 we have a reversal of the direction of causality from beta to return. In other words, it is possible to hypothesise that in the case of these portfolios, the low returns are actually *creating* the outcome betas. Thus, firms that buck the market by performing unexpectedly well when the market declines (resource stocks, for example) have positive returns and thereby a negative beta. Similarly, when stocks (of a banking sector, or a Qantas or a Telstra, for example) unexpectedly pull the market down, such stocks have negative returns and highly positive betas. Other "stories" are possible here, but it is salutary that researchers be aware of the possibility of reversal of the directions of causality in their data. For example, a linear regression (not reported here) applied to the U-shape of Figure 1 not unexpectedly reveals no statistically significant correlation between beta and returns (thereby missing the linear structure across beta upward of the lower-beta portfolios). Similarly, for example, Faff (2001a) has applied a linear regression methodology to the Australian data and reported that beta has no explanatory power for stock returns.

A.2 Firm Size (Figure 2)

Turning to the relationship in Figure 2 between portfolio returns and market capitalisation, we observe that the relationship is declining with market capitalisation. Thus, the graph appears to be broadly consistent with the relationship reported for non-Australian stocks by Spiegel and Wang (2005). However, we observe that the inverse relationship is only appropriate for quite low market capitalised firms. We also note that Chan and Faff (2003) report a *flat* regression relationship between returns and market capitalisation for Australian stocks. As an outcome of the filters imposed for stock selection (insufficiently traded stocks being excluded) it is possible that stocks driving the return performance for 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 both Brown et al. (1983) and Beedles et al. (1988) (for Australia) who find that the size effect is effective only for their smallest stocks.

A.3 Liquidity (Figure 3)

In relation to the portfolio return-liquidity relationship, Figure 3 reveals a rather flat relationship. The literature generally (and Chan and Faff (2003) for Australian data) reports a *negative* relationship between stock returns and the liquidity measure used here. We observe that the low-market capitalisation stocks (portfolios 1 and 2) that give the high returns in our analysis (Figure 2) are those with the highest turnover and hence highest liquidity. So again, it is possible to hypothesis how a direction of causality might be reversed. Small stocks tend to trade more frequently when they are increasing in value. That is to say, it is possible that such stocks have high liquidity *because* they are performing well, rather than that their returns are an outcome of their high liquidity. In which case, it is possible to speculate that such directions of causality between the variables are confounding one another in the flat relationship observed in Figure 3. Notwithstanding, 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.

A.4 Idiosyncratic Volatility (Figure 4)

Figure 4 displays the relationship between portfolio returns and idiosyncratic volatility. The relationship between both equally-weighted and value-weighted returns and idiosyncratic volatility are pronounced as well as dramatically contradictory of each other. The equally-weighted returns are monotonically increasing as consistent with Malkiel and Xu (1997). The downward direction of the value-weighted portfolio returns from portfolio 4 onwards is however most dramatic. Clearly, larger capitalised stocks with higher idiosyncratic volatility are somehow associated with *declining* returns. It is possible that increases in volatility in the market place are indicative of apprehension and tend to presage declines. In other words, it is again possible to hypothesise directions of causality: investors require higher returns for taking on higher idiosyncratic volatility, and declining prices and lower returns of large stocks are presaged by higher levels of idiosyncratic volatility.

B. Double Sort Portfolios

Pair-wise sorts on variables allow examination of the explanatory power of one variable while controlling for the explanatory power of a second variable. With four variables (beta, firm size, liquidity and idiosyncratic volatility) we have 6 pair-wise sorts for which we calculated equally-weighted returns averaged over a portfolio's stocks for the sample period. The 2-D graphs of our results are presented in Figures 5-10 and the tabulated values are summarised in panels A-F of Table 3. The essential observed trends are summarised as follows.

B.1 Beta and Firm Size (Figure 5)

Figure 5 confirms that very small firms are associated with sharply higher returns (as Figure 2 above). Here, the explanatory power of beta is not strong and is in fact generally downward with exception for the smaller stock deciles across which we have a somewhat U-shape (as in Figure 1). The flat linear regressions applied across each decile of market capitalisation accords with the Fama and French proposition that controlling for market capitalisation reveals little if any explanatory power for beta-based regressions.

B.2 Beta and Liquidity (Figure 6)

In Figure 6, a mild U-shape dependence of returns on beta is discernable. Overall, beta and liquidity are displaying little explanatory power.

B.3 Firm Size and Liquidity (Figure 7)

Figure 6 once again confirms the dramatic negative market capitalisation effect and the flat relationship with liquidity. This is consistent with Anderson et al. (1997) who show that liquidity is not significant and does not explain the firm size effect.

B.4 Idiosyncratic Volatility and Beta (Figure 8)

Figure 8 confirms the dominance of idiosyncratic volatility over beta. Controlling for beta, portfolios of higher idiosyncratic volatility stocks display higher returns. Controlling for idiosyncratic volatility, portfolios of higher beta stocks display slightly lower returns. Overall, it is notable that the portfolio return performances improve dramatically as we go from portfolios formed on low idiosyncratic volatility and high beta (which returns are negative) to portfolios formed on high idiosyncratic volatility and low beta.

B.5 Idiosyncratic Volatility and Liquidity (Figure 9)

Figure 9 confirms the dominance of idiosyncratic volatility over the liquidity variable. The patterns are similar to those of Figure 8 with liquidity replacing beta. Thus, controlling for liquidity, portfolios of higher idiosyncratic volatility stocks display higher returns. And controlling for idiosyncratic volatility, portfolios of higher liquidity stocks display somewhat lower returns. Again, it is notable that portfolio return performances improve dramatically as we go from portfolios formed on low idiosyncratic volatility and high liquidity (which returns are negative, as Figure 8) to portfolios formed on high idiosyncratic volatility and low liquidity.

B.6 Idiosyncratic Volatility and Firm Size (Figure 10)

Figure 10 re-confirms the superior performances of low-capitalisation stocks (as Figures 2, 5 and 7). The figure reveals a well-defined relationship between portfolio returns and idiosyncratic volatility for smaller stock portfolios 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 firms are positive predictors of stock returns; while Angelidis and Tessaromatis (2005) find evidence that the idiosyncratic volatility of small stocks is associated with the small capitalization premium.

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 small stocks. We note that the largest firms with high idiosyncratic volatility in Figure 10 (portfolio (10,10)) have a marked negative return (consistent with Figure 4 where value-weighted portfolio returns decrease with idiosyncratic volatility). Thus, we have additional confirmation that although idiosyncratic volatility dominates over beta and liquidity (Figures 8 and 9), idiosyncratic volatility only adds significant explanatory power in relation to market capitalisation for very small market capitalised firms.

V. Conclusion

Consistent with Fama and French (1992), we find that while the returns for portfolios of Australian stocks with higher beta generally exceed those of lower (but still remaining positive) betas, the explanatory power of such beta largely disappears when we control for firm size. Our findings are consistent with Fama and French (1996) in that we document that smaller capitalisation firms have returns markedly higher than for portfolios of larger firms. Conflicting with Fama and French's findings, however, the capitalisation (size) effect in our data is evident only for stocks that fall below a certain threshold of firm capitalisation. In effect, for firms of smaller size than the threshold size, the association of higher returns with decreasing firm size is dramatic, while for firms greater than the threshold, we find no evidence of the size effect. These findings are roughly consistent with previous Australian findings (by Brown et al., 1983 and Beedles et al., 1988).

Our findings are also consistent with Malkiel and Xu (1997, 2006) in that we report (a) that a stock's capitalisation is highly negatively correlated with its idiosyncratic volatility (Malkiel and Xu, 1997), and (b) that a stock's idiosyncratic volatility is a stronger determinant of returns than beta (Malkiel and Xu, 2006). However, the strong correlation between idiosyncratic volatility and returns in our data exists predominantly for smaller firms below a certain level of capitalisation.

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

We have hypothesised a range of anomalies to our findings as the outcome of a reversal of causality between returns and the considered explanatory variables. Two instances are particularly significant. Firstly, it appears that Australian equities have a significant number of small firm-size stocks that have continued to perform well against otherwise declining markets and consequently have quite high returns in combination with a low or even a negative beta. Also, it appears that a number of large stocks have on occasion contributed to leading the market down, and that such stocks consequently have low returns combined with a high beta. The outcome is that the value-weighted returns for higher beta portfolios are decreasing in beta (while the equally-valued returns for higher beta portfolios (our portfolios 3-10) are increasing). Additionally, we have hypothesised that declines of stocks of large firms are often presaged by an increase in stock idiosyncratic volatility, implying that for portfolios containing large capitalised firms, value-weighted returns may be decreasing with idiosyncratic volatility (while equally-valued returns are increasing with idiosyncratic volatility).

From a research perspective, we conclude that researchers may need to be cognisant of such "reversals of directions of causality" as revealed in our findings. From a theoretical perspective, we summarise by stating that we do not have evidence of a systematic relationship between beta and returns independent of the firm's size. Our overwhelming evidence is that portfolios of stocks of very small firms outperform the market and that for such small-firm portfolios, firms with higher idiosyncratic volatility have had quite dramatically higher returns over Australian stock market history.

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Figure 1

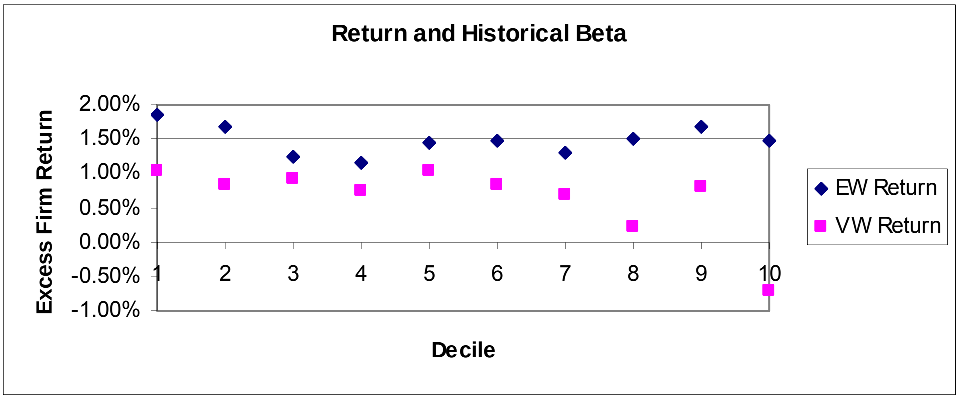

Figure 2

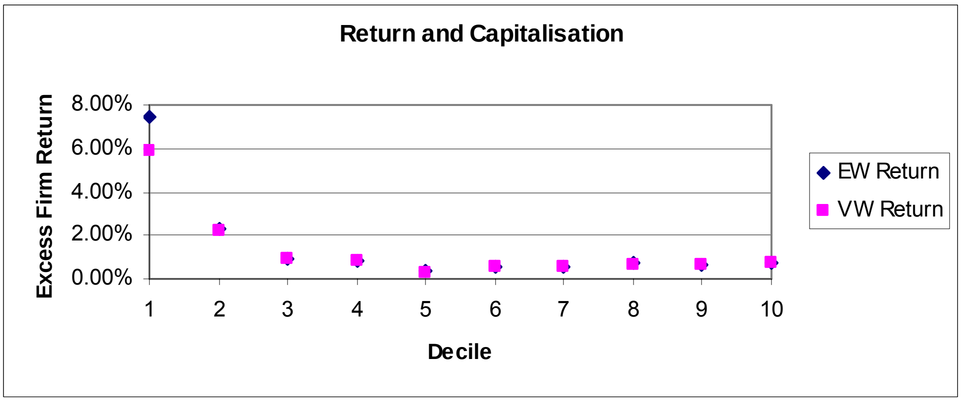

Figure 3

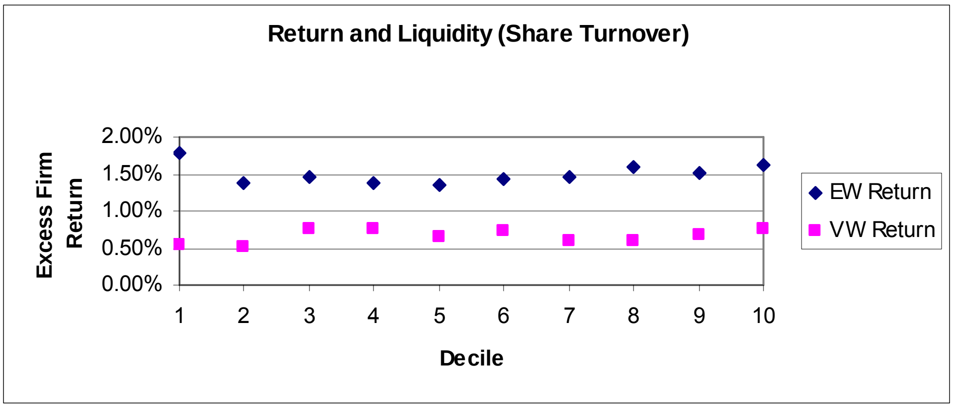

Figure 4

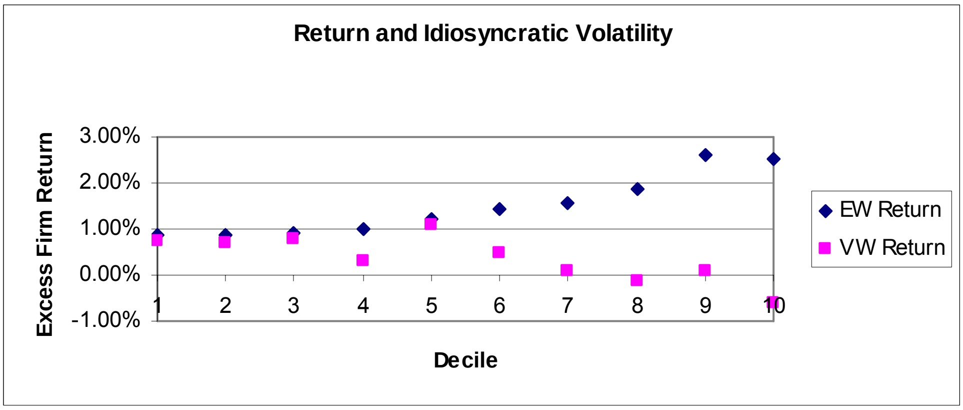

Figure 5

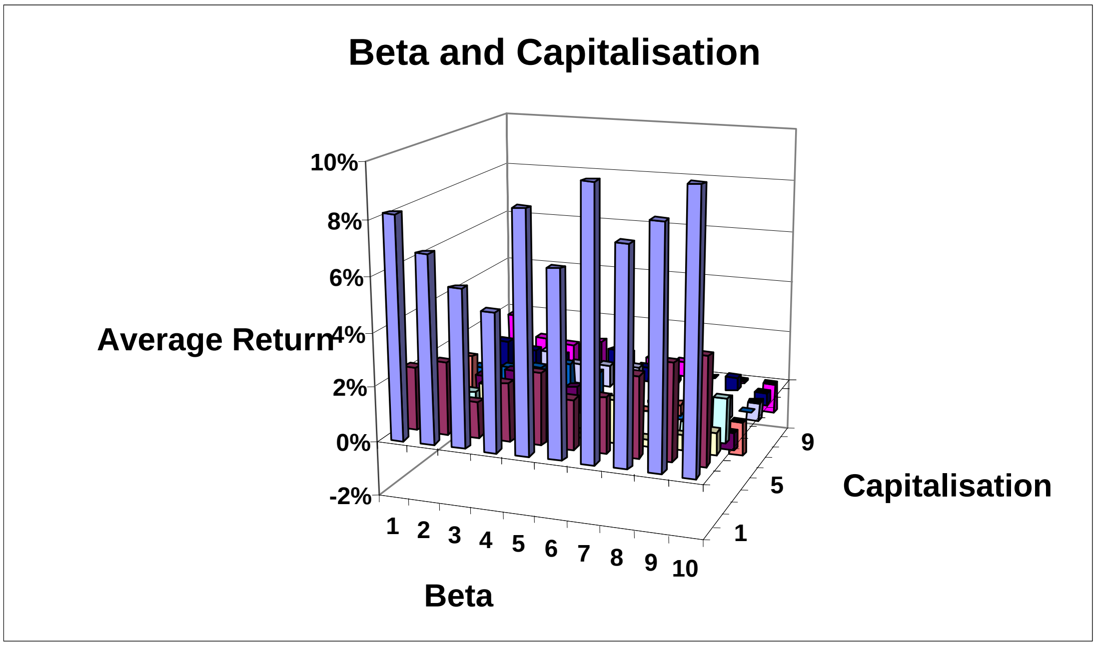

Figure 6

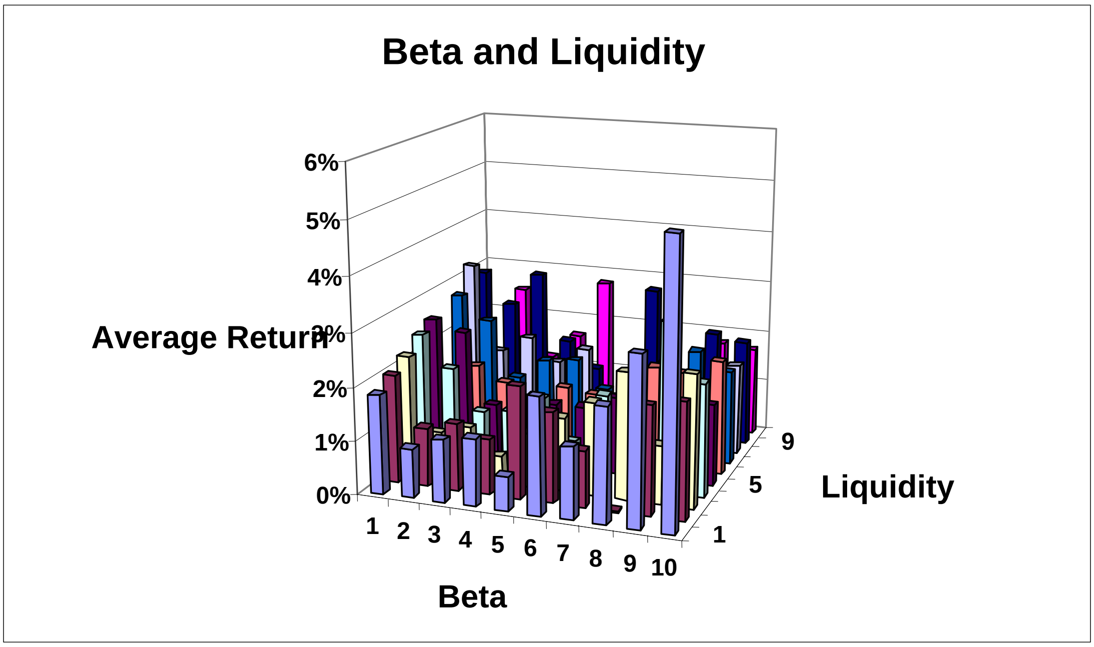

Figure 7

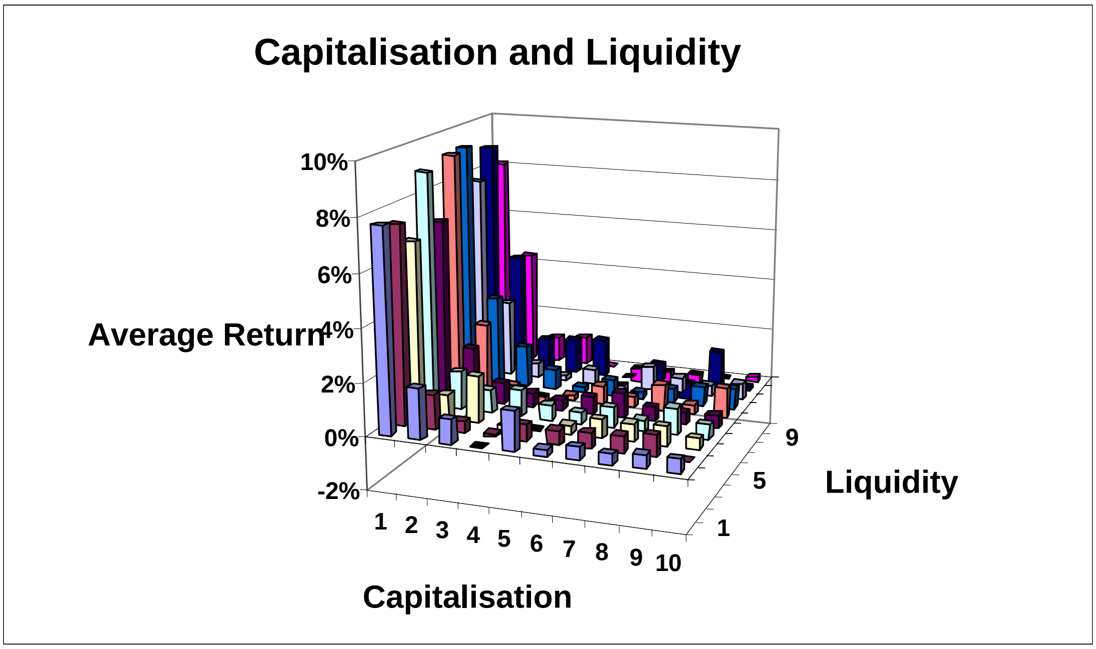

Figure 8

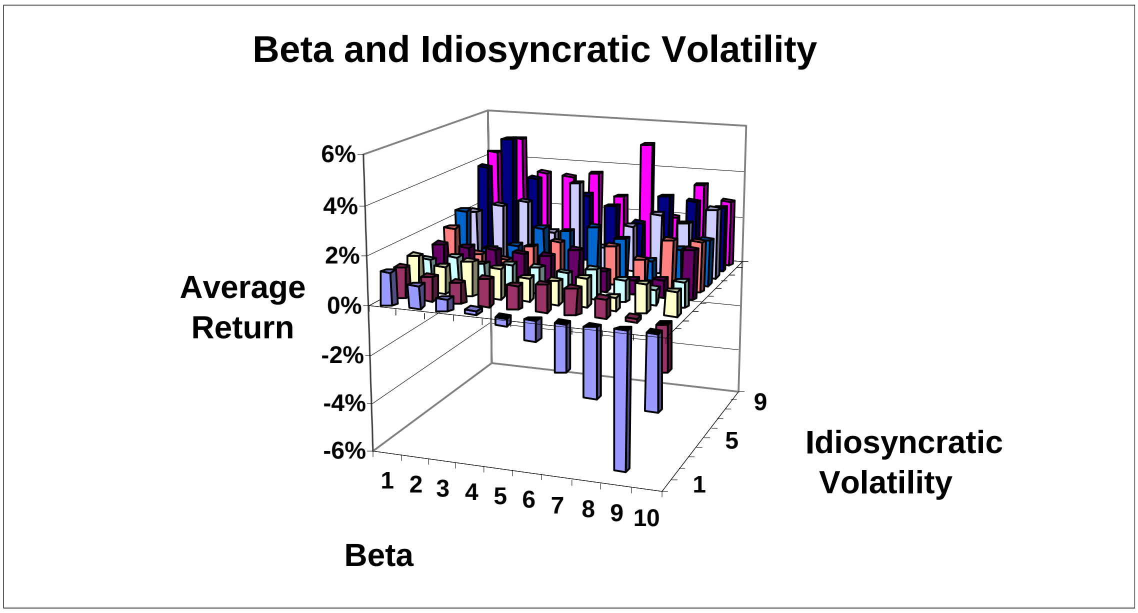

Figure 9

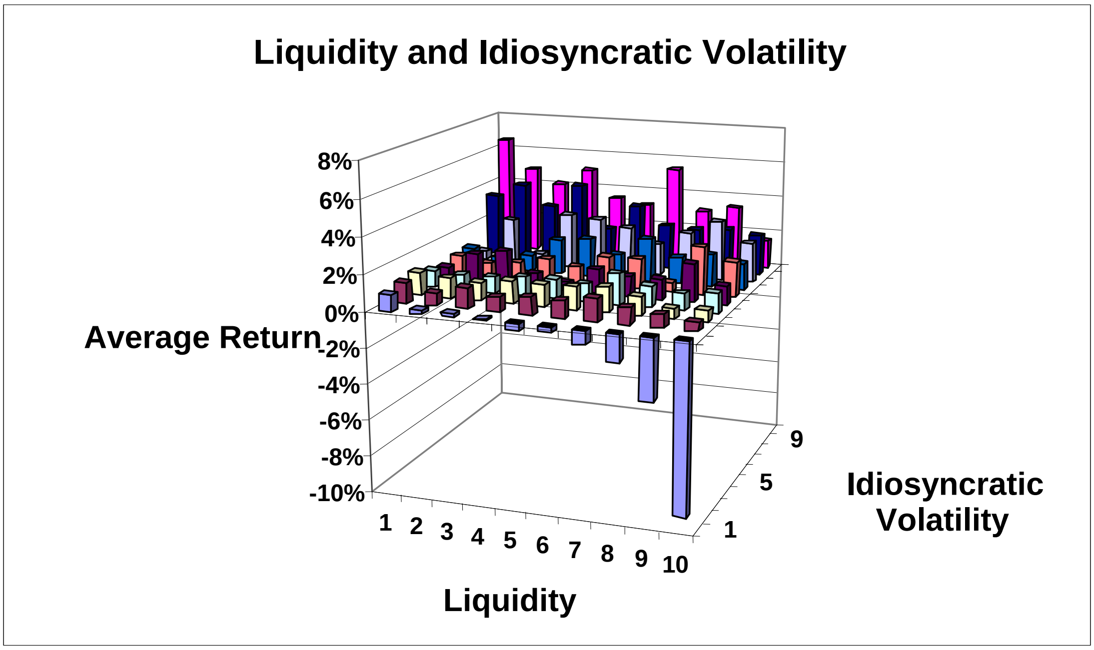

Figure 10

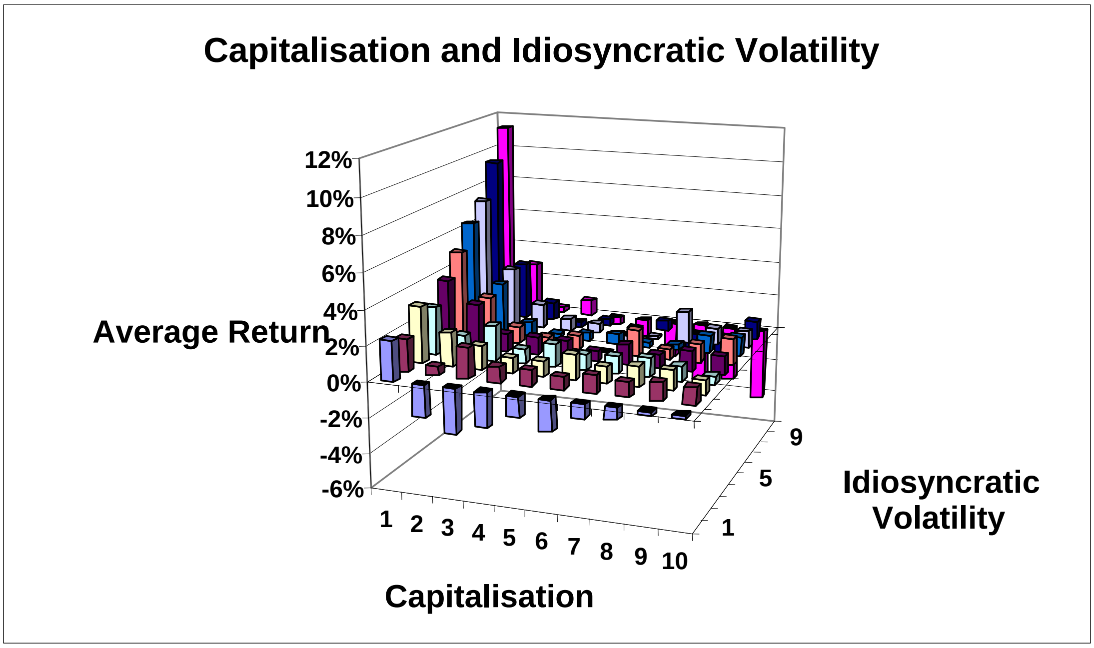

Table 1
Average Monthly Returns of Portfolios Formed on Beta, Size, Liquidity and Idiosyncratic Risk

We calculate average monthly returns for portfolios formed on beta (β), firm size (MC), liquidity (LIQ) and idiosyncratic volatility (IV) for the period 1980 through 2003. In each month, *t,* all stocks are ranked separately on beta, size, 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 over the time period. Panel A reports return for portfolios formed on beta, where decile 1 is for stocks with the lowest beta. Panel B reports returns for portfolios formed on size where decile 1 is for the smallest stocks. Panel C reports returns for portfolios formed on liquidity where decile 1 is for the least liquid stocks. Panel D reports returns for portfolios formed on idiosyncratic volatility where decile 1 is for stocks with the lowest idiosyncratic volatility.

Panel A: Portfolios Formed 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 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 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 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%

Table 2
The relationship between Beta, Size, Liquidity and Idiosyncratic Risk

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

Panel A: Portfolios formed 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 on firm 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%

Table 2– Continued

Panel C: Portfolios formed 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 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%
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%

Table 3
Average Monthly Returns of Portfolios Formed by Two-dimensional sorts on Beta, Size, Liquidity and Idiosyncratic Risk

We calculate average monthly returns for portfolios formed 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 for Tables 1 -> 4) according to its ranking on each of the four variables. Thus, each stock is allocated to 4 portfolios (1->10). Portfolios 1->100 are then formed on pairs of the variables based on cross-rankings of their allocation 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 capitalisation is assigned to portfolio (1,1), a stock from portfolio 1 of lowest betas and from portfolio 2 of next-to-lowest market capitalisation 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 time period. Panel A is for portfolios formed on β and size. Panel B is for portfolios formed on β and liquidity. Panel C is formed on size and liquidity. Panel D is for portfolios formed on β and idiosyncratic volatility. Panel E is for portfolios formed on liquidity and idiosyncratic volatility. Panel F is for portfolios formed on size and idiosyncratic volatility.

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%
MC10	1.81%	0.97%	0.79%	1.03%	0.66%	0.61%	0.55%	-0.05%	-0.09%	-1.15%

Table 3 - Continued

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%
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%

Table 3 - Continued

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%
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%