“The significance of beta for stock returns in Australian markets”

AUTHORS	Michael Dempsey https://orcid.org/0000-0002-9059-0416

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Michael Dempsey (Australia)

The significance of beta for stock returns in Australian markets

Abstract

We report that betas of portfolios of Australian stocks possess a high level of stability, implying that beta is a meaningful measure of a portfolio's market risk exposure. Further, by allowing broad demarcations of company size and liquidities, we show that beta appears not to be rewarded continuously, but discretely, across thresholds of company size and stock liquidity. We conclude that beta remains relevant in the description of the risk-reward structure of asset pricing in Australian markets.

Keywords: beta, firm size, liquidity.
JEL Classification: G10, G12, G15.

Introduction

Eugene Fama's quote that "beta as the sole variable explaining returns on stocks is dead" (New York Times, February 18, 1992) has been widely circulated as: "beta is dead". However, the fact that the average returns of stocks might not be in accordance with their betas as predicted by the capital asset pricing model (CAPM) does not negate the usefulness of beta as a measure of a stock's market risk exposure. If a stock's beta is consistent across time, then beta – by definition – is a meaningful measure of its market exposure.

Black (1993), building on the study of Black, Jensen and Scholes (1972), documents strong beta stationarity over the period of 1931-1991, leading to the observation that beta is "more useful if the line (of returns against beta) is flat than if it is as steep as the CAPM predicts" (p. 17). The stability of beta for U.S. stocks is also highlighted in the study by Grundy and Malkiel (1996), who observe that portfolios of U.S. stocks comprised of high betas over the period of 1968-1992 consistently fell *more* in market declines than portfolios of stocks of low betas. As the authors point out, their results, ultimately, are a test of the stability of their beta portfolios.

However, Fama and French (1992, 1993, 1996, and elsewhere) argue that beta by itself is not an effective variable in explaining the cross-section of stock returns. Although portfolios comprising higher beta stocks tend to earn higher returns, the relationship effectively disappears once company size is controlled for. In Australian markets, Durack, Durand and Maller (2004) confirm the findings of Fama and French in finding that the explanatory power of the CAPM is poor. Faff (2001a) actually fails to find a statistically significant relation between beta and returns in Australian markets.

Although the Australian stockmarket (*ASX*) is much smaller than U.S. markets (the 200th company is capitalized at approximately $150 million), it provides opportunities for realistic robustness tests in regard to asset pricing in other markets (see, for example, Ghrghori, Chan and Faff (2006) for further details as to the market's unique setting). As a brief summary as relevant to our paper, we note that although Ball, Brown and Officer (1976) originally found evidence of a positive relationship between average returns and beta for a sample of industrial firms in the Australian market, Wood (1991) found only weak such evidence in Australian markets and Faff (1991) found only moderate evidence, while Faff (2001a), as we have noted, reported no relationship between beta and returns for the standard CAPM. In the context of Australian markets, Halliwell, Heaney and Sawicki (1999) have replicated the Fama and French (1993) three-factor study and found that the magnitude and statistical significance of the beta, firm size 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. In Australian markets, Beedles, Dodd and Officer (1988) have found that large firms have greater liquidity and suggest that liquidity partially explains the size effect (as, for example, Amihud (2002) in the U.S.), while Anderson, Clarkson and Moran (1997) reported that they fail to find a significant relationship between abnormal returns and liquidity.

In such context, the present paper allows for a reappraisal of the portfolio return-beta relationship in Australian markets. Additionally, we examine the constitution of a portolio's beta in terms of its "downside" and "upside" components (its beta as measured over market downturns and upturns, respectively). We also examine the performance of portfolios over designated "bull" and "bear" periods of the Australian markets as a function of their beta. Finally, the paper examines the structure of portfolio returns as a function of their beta while accounting for the average company size and liquidity of the stocks.

Our portfolio analysis approach calculates stock returns across compartmentalized ranges of beta.

The portfolio approach is simple and robust. It is the method advocated by the late Fischer Black (Black, 1993; Mehrling, 2005, p. 112). Although it lacks statistical tests – as compared with, for example, the Fama and Macbeth (1973)/Fama and French (1992) method – Black's argument was that the method simulates the portfolios that investors might actually use, and rather than providing a "once-off" analysis, the method tends to give guidance as to where to look for the next most promising theoretical enhancements. And unlike linear regression tests, the portfolio method does not assume any specific functional form for the relations among the variables.

Of necessity, we have imposed limitations on the scope of our paper. In principle, we might have extended our survey of beta portfolios beyond the characteristics of firm size and stock liquidity, to encompass such as book-to-market-equity value, idiosyncratic volatility, momentum, and so on. We know, however, that beta is strongly inversely related to firm size (Cochrane, 2005, p. 438, for example) and that size has strong associations with stock liquidity (Amihud, 2002; and Beedles et al., 1988 in Australian markets, as noted above). Hence our justification for our scope.

Our findings may be summarized as follows. The portfolio betas in our sample are sufficiently consistent as to be a meaningful measure of a portfolio's market risk exposure. Further, this consistency is observed over market upturns and downturns, measured both as monthly variations and as prolonged "bull" and "bear" periods of the markets (high beta stocks, for example, generally decline more than low beta stocks in bear markets). However, the explanatory power of beta in relation to returns does not apply continuously – or even monotonically. Rather, it applies discretely in relation to broad categories of company size and stock liquidity.

Within such categories we summarize our results as follows. We find that stocks of larger company size (over \$500 million capitalization) dominate the middle range of beta (0.65 < beta < 1.3), while stocks of small/medium company size (between \$150 million and \$500 million capitalization) dominate both somewhat lower and somewhat higher beta ranges (0.25 < beta < 0.65 and 1.3 < beta < 2.25). It is noteworthy that portfolio returns increase significantly across these three ranges of increasing beta. However, within each of these three beta/size ranges, we find that returns are not overly sensitive to the beta of the stock. Our final two beta/size ranges are for stocks of the very smallest company sizes (less than \$150 million capitalization) dominate the extremely low and extremely high beta ranges (beta < 0.25 and beta > 2.25). We observe that stocks of the lowest beta have abnormally high returns, which leads to an overall "hockey-stick" return-beta relationship. These stocks are, however, characterized by very low trading volumes, which limit the practical opportunity to arbitrage. The stocks of very high beta of the smallest company sizes have high returns on average and are typically characterized by high turnover rates.

The rest of the paper is arranged as follows. In Section 1 we outline the data, measurements of variables, and the methodology. In Section 2 we present the results for the performances of beta portfolios in three sub-sections. In sub-section (2.1.) we present our returns for portfolios constructed on beta, as well as our observations for the composition of the portfolio betas in terms of their respective sensitivities to market upturns and downturns. In sub-section (2.2.) we present our results for the return performances of the portfolios formed on beta over designated "bull" and "bear" periods. In sub-section (2.3.) we present our results for the characteristic composition of the beta portfolios in terms of the average company size and liquidity of their stock. The last section summarizes the findings and concludes the paper.

1.2. Data, variables and methodology

1.1. Data. We use data from the Australian Graduate School of Management (AGSM) database of ordinary common stocks listed on the Australian Stock Exchange (ASX) to construct portfolios of stocks. The dataset initially held 450,489 monthly price observations from 3,922 companies trading over 372 months (January 1st, 1974 to December 31st, 2004). From the set, 6,960 monthly observations were removed due to missing data (not having a date or appearing as duplicate records). To calculate a stock's monthly return, we required that a stock traded in the previous month, and to calculate the beta for such month, we required that a stock traded in 35 out of the previous 60 months. This left a total of 265,535 monthly stock observations for analysis, beginning January 1st, 1979. The descriptive statistics of our sample are presented in the central column of Table 1.

From the Australian Securities Industry Research Centre of Asia-Pacific (SIRCA) database, we obtained data on daily trading volumes. These were aggregated to give monthly trading volumes for 279,663 observations. In order to calculate a stock's liquidity, we required that the stock had traded in each of the two previous months. Using the AGSM security code and month, these data were matched to the observation from the AGSM database. This created 190,218 monthly matched observations of monthly stock returns, company size and stock liquidity. The average market capitalization of the reduced sample was $398 million over 2,347 companies (which compares with $349 million over 2,635 companies for the original dataset), which implies that it is the stocks of smallest market capitalization that have been removed. The descriptive statistics of the sample are presented in the final column of Table 1.

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

1.2.1. Measurement of stock returns ($r_{i,t}$). Returns ($r_{i,t}$) are measured as the difference between the dividend-adjusted closing price at the end of month t and the closing price at the end of month t - 1: $r_{i,t} = (p_{i,t} - p_{i,t-1})/p_{i,t-1}$, where $p_{i,t}$ is the dividend-adjusted price of the stock at the end of month t. Thus a portfolio's return is associated with the month after the portfolio is formed. Returns are excess returns with the risk-free rate proxied as the three-month Treasury bill rate.

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

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

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

The upside beta (β^+) and downside beta (β^-) for each asset i at the end of each month t is calculated over separate subsets of the previous 60 months of data as:

$$\beta^-_{i,t} = \frac{\text{cov}(r_i, r_M \mid r_M \le \mu_M)}{\text{var}(r_M \mid r_M \le \mu_M)},$$

$$\beta^+_{i,t} = \frac{\text{cov}(r_i, r_M \mid r_M \ge \mu_M)}{\text{var}(r_M \mid r_M \ge \mu_M)},$$

where μ_M denotes the median monthly market return r_M over the 60-month period.

1.2.3. Measurement of company size. Company size at the end of each month t is measured as the market capitalization of the company's stocks – i.e., the number of shares outstanding multiplied by the share price at the end of the month.

1.2.4. Measurement of stock liquidity (turnover). Liquidity is variously defined in the literature[1]. Here, following both Datar, Naik and Radcliffe (1998) and Chan and Faff (2003), we use share turnover as a proxy for liquidity, and (using Australian data), for each stock i at the end of each month t, calculate:

$$liquidity_{i,t} = \frac{monthly\ trading\ volume_{i,t}}{number\ of\ shares_{i,t}},$$

where for each stock i at time t, monthly trading volume is calculated as the average trading volume of the stock over the previous three months – *t-3, t-2* and *t-1* – divided by the number of shares outstanding in that month[2].

1.3. Methodology. We wish to observe the returns of assets as a function of their beta. Additionally, we wish to observe the composition of beta in terms of its β^+ and β^- components, as well as the stability of these components over market upturns and downturns.

To this end, at the beginning of each month, stocks i are ranked according to their betas (β_i) and assigned to decile portfolios, with the lowest-beta stocks making up the first decile and the highest-beta stocks the tenth decile. The portfolios are rebalanced monthly and portfolio betas are determined as the mean beta of the portfolio's composite stocks, with an equal weighting assigned to each stock in the portfolio. For each month, we calculate the equally-weighted average cumulative return of each decile portfolio in excess of the one-month T-bill rate. The return assigned to each decile portfolio then corresponds to the average time-series excess portfolio return over the period of 1979-2004.

For each portfolio, we also calculate the upside and downside betas of the stocks in the portfolios. This allows for an assessment of the formation of the betas of stocks in terms of sensitivity to upturns and downturns in the market. The approach for forming portfolios based on beta is repeated by forming portfolios based on the downside beta of the stocks. This serves to identify the formation of the betas of stocks in terms of constituent upside and downside components.

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[1] For example, Amihud and Mendelson (1986) use bid-ask spread; Brennan, Chordia and Subrahmanyam (1998) use dollar volume; Amihud (2002) uses an alternative variation of liquidity; Datar et al. (1998) and Chan and Faff (2003) use turnover (as here).

[2] Datar et al. (1998) find that defining the average number of shares traded over the previous month, six months, nine months and a year do not significantly alter their findings.

In order to investigate more fully the nature of cross-sectional returns and asset betas, we consider the performance of Australian stocks over periods of significant increases and declines. As in Grundy and Malkiel (1996), we look at periods when the market drops by 10% or more from peak to trough. Additionally, we look at periods when the market gains by 10% or more from trough to peak. Using this criterion, 10 periods of market decline and 9 periods of market increase are identified. Again, betas for each stock i at time t are calculated over a 60-month period prior to time t, and portfolio betas are determined as the mean beta of the portfolio's composite stocks, with an equal weighting assigned to each stock in the portfolio. Portfolio returns over the period of market decline are then determined by calculating the mean return of all stocks in a given decile, with an equal weight assigned to each stock in the portfolio. Aggregate results are determined by grouping all first deciles from each of the periods and recalculating a mean decile beta and mean decile return on an implied monthly basis. The process is repeated for subsequent deciles.

Finally, we investigate the company size and liquidity characteristics of the beta portfolios. To achieve this, the average company size and liquidity for each stock of each beta portfolio is measured at each monthly portfolio formation, and the average value is assigned to the portfolio. We thereby assign characteristic company sizes and stock liquidities to the beta portfolios.

2. Results

Our results have essentially three components: first, the relation between returns and beta between 1979 and 2004, where we examine the stability of beta and the composition of beta in terms of its measurement over market upturns and downturns; second, the meaningfulness of return-beta relationships in the context of pronounced and protracted "bull" and "bear" markets; third, the manner in which beta appears to be related to stock returns in terms of thresholds of beta values (rather than continuously) across demarcations of company size and liquidity. We discuss each of these components below.

2.1. The performance of Australian stocks as a function of beta. Figure 1 and the first three columns of Table 2 display the overall return performance of the portfolios of Australian stocks against their beta (β) over the period of 1979-2004. The overall returns appear high and are the outcome of stocks of the smallest companies. The value-weighted average excess return (above the three-month Treasury bill) for the whole sample period was approximately 9%. We observe that portfolio 1 (with lowest betas) outperforms portfolios 2 to 7 (with higher betas). The average beta for stocks in the lowest beta portfolio is negative (-0.9) and the betas for the stocks in the highest beta portfolios (7-10) are high (1.5-3.2). Also, the returns for both the lowest beta portfolio and the very high beta portfolios are very high. These portfolios outperform the equally-valued standard ASX market indices to such extent that it is anticipated that the stocks of these portfolios represent the smaller companies in the dataset. We note also that returns do not appear to differ substantially across portfolios 5-7 (with beta range approximately 0.6-1.3). Otherwise, when the two very low beta portfolios (1 and 2) are excluded, portfolio returns appear to generally increase with beta.

The high returns observed for both the very low and very high beta portfolios prompt us to ask how the stocks of such portfolios perform during market downturns. If the betas for the stocks of the portfolios are consistent across market upturns and downturns, the returns of high beta stocks (notwithstanding their overall high performance) should actually *under*-perform the market during the periods of market downturn. Equally, we wish to observe the extent to which the performance of the very lowest beta portfolios is an outcome of the performances of their stocks across both market upturns and downturns.

The downside (β) and upside (β^+) betas for the decile portfolios of Figure 1 are displayed in the final two columns of Table 2. The degree to which we find that portfolios formed on conventional beta increase monotonically in β^- and β^+ is striking – stocks that on average amplify (underplay) market performances also tend to amplify (underplay) both market upturns and market downturns.

Following the same procedure as for conventional betas (β), we created decile portfolios for downside betas (β^-). A formation of portfolios on β^- implies that the portfolios are formed independently of the return observations needed to calculate β^+. We then calculated the conventional beta (β) and upside (β^+) betas of these portfolios. The results are displayed in Table 3. With the exception of portfolio 1, a ranking on downside betas generates portfolios of both monotonically increasing upside betas and monotonically increasing conventional betas. So again, a striking consistency of upside and downside betas is confirmed.

We complement here the work on time-varying betas that have appeared to allow for a better explanatory power for the capital asset pricing model (notably, Durack et al., 2004, in Australian markets; Lettau and Ludvigson, 2001, and Chordia and Shivakumar, 2002, for U.S. markets). Notwithstanding such contributions, we conclude that beta is a meaningfully consistent measure of an asset's market risk exposure.

2.2. The performance of Australian stocks as a function of beta over periods of distinctive bull and bear markets. The observed consistency of average portfolio betas across market upturn and downturns suggests the possibility that portfolios formed on beta might be exposed not only to incremental monthly market changes in relation to their beta, but also to prolonged "bull" and "bear" markets in relation to their beta.

Figure 2 and Table 4 display our nine designated "bear" market periods for the All Ordinaries Index (XAO). We notice that the duration of each bear market is a little over ten months, which is only about half the duration of the average bull market. Also apparent is the "October '87 crash" in which the domestic market index shed approximately 30% of its value in one trading day – the 20th of October, or "Black Tuesday". In a similar manner, we consider "bull" markets as increases of 10% or more from trough to peak. Figure 3 and Table 5 similarly display the characteristics of each bull market. We notice that prior to the "October '87 crash", the XAO increased by over 240% over a 40-month period. The table also reveals that the duration of each bull market is a little over twenty months, with average monthly increases ranging from 1.0% to 6.0%.

Figure 4 (and Table 6) displays the performances of portfolios ranked on beta for market downturns. In particular, we note that portfolios 1 and 2 of lowest (negative) beta stocks actually perform against the market (with positive returns) in market declines. Thus the rewards for holding the very lowest beta (negative or close to zero) stocks appear to be confirmed as anomalously high (in that these portfolios show themselves robust to market declines while outperforming the portfolios of moderately low beta stocks, as in Figure 1). The returns for portfolios 6-10 trend down with portfolio beta (with an upturn for portfolio 10). However, we observe a distinct plateau return-beta relationship for the broad range of beta portfolios 3-7 (with betas in the range of approximately 0.3-1.3).

Figure 5 (and Table 7) displays the return performance of portfolios ranked by beta for market upturns. We note again that the returns for the very lowest beta portfolios – 1 and 2 – are anomalously high considering their low beta. At the other end, the returns for high beta portfolios – 7-10 – trend sharply up with portfolio beta, which more than compensates for their underperformance in market downturns (Figure 4) as revealed in Figure 1. We note that as in Figure 4 for the downturn market, and in Figure 1 for the market overall, we have a flat relationship of returns with beta persists for the middle range of beta portfolios 5-7 (with betas in the range of approximately 0.65-1.3).

2.3. The performance of Australian stocks in relation to company size and liquidity. We have anticipated that the very high portfolio returns in Figure 1 (deciles 1 and 8-10) are the outcome of stocks of small company size with likely low liquidity. To test this premise, we investigated the structure of cross-sectional returns and asset betas in relation to the average underlying company size and level of trading activity of the stocks in the portfolios formed on beta.

The need for a liquidity measurement led to the deletion of approximately 20% of the observations. The deletion of less-consistently traded stocks in the culled dataset acts as a robustness check on our findings by repeating the calculations of average portfolio returns as a function of portfolio beta (Figure 1 and Table 2). The results are presented in Table 8. The elimination of less-consistently traded stocks eliminates the very high portfolio returns in Figure 1. Thus the revised dataset presents a new complexion on the data. It is salutary to observe how observations of asset pricing performances are affected by the inclusion of stocks that, due to their small company size along with liquidity constraints, may actually be insignificant from the perspective of professionally-held portfolios.

Table 8 is striking in other respects. The average company size of the stocks in the portfolios appears to be distributed roughly symmetrically about the middle beta portfolios (5-7). Stocks of the companies ranked 150th to 200th by market capitalization are technically designated "small capitalized" in the S&P/ASX indices, with the 100th company capitalized at approximately \$2 billion and the 200th company capitalized at approximately \$150 million. If we compartmentalize companies as "large" (over \$500 million), "medium" (\$150-\$500 million) or "small" (under \$150 million), a number of generalizations present themselves. These are summarized in Tables 8 and 9, and discussed briefly below.

2.3.1. Stocks of large company size (over \$500 million equity capitalization). These stocks are characterized as having betas in the range of 0.65-1.3, for which there appears to be little variation of return performance with beta. This is consistent with the observations of portfolios in this beta range for the market overall (Figure 1), and for market upturns and downturns (Figures 4 and 5).

2.3.2. Stocks of medium company size ($150-$500 million equity capitalization). These stocks dominate both the beta range of 0.25-0.65 *and* the beta range of 1.3-2.25. Again, we do not find that the returns for stocks within each of these separate ranges are strongly related to their beta. However, the stocks in the higher beta range (1.3-2.25) have returns that are, on average, markedly greater than the returns of the stocks in the lower beta range (0.25-0.65). Further, the returns of the stocks of the largest companies (with betas mid-way between the betas of the two sets of medium-sized stocks) have returns that, on average, fall between the returns for the two sets of medium-sized stocks.

2.3.3. Stocks of the smallest companies (under $60 million equity capitalization). These stocks dominate both the very low beta (less than 0.25) and very high beta (greater than 2.25) ranges. The returns for stocks with beta greater than 2.25 appear to be either about the same as (or slightly lower than) the returns for the stocks of medium-sized companies in the beta range of 1.3-2.25, while the returns for stocks with beta less than 0.25 appear higher than for any other range of beta.

2.3.4. Portfolio performance and liquidity. Finally, we also observe that if we exclude the small-size companies with betas less than 0.25, the level of trading activity for the portfolios appears to increase as we go from the lower beta portfolios with lower returns to higher beta portfolios with higher returns. The literature (including Chan and Faff (2003), who use Australian data) generally reports a *negative* relationship between stock returns and the liquidity measure used here. The supporting argument is that investors are prepared to pay a premium for stocks with higher liquidity. It is possible, however, to hypothesize how this direction of causality might become reversed – that stocks might acquire higher liquidity *because* they are performing well, as opposed to their returns representing an outcome of their high liquidity. However, when we include the small-size companies with betas less than 0.25, the returns to liquidity relationship is obscured (not reported here). In this case, our findings are more consistent with Anderson et al. (1997) who, as noted above, fail to find a strong relationship between liquidity and size in the Australian market.

Conclusion

The present study has investigated the relation between stock returns and beta for Australian equities over the period of 1974-2004. We adopt a robust portfolio approach that relates average stock returns to the average betas of the stocks. Thereby, we have observed the extent to which calculations of equally-weighted returns on an explanatory variable, such as beta, may be affected dramatically by the stocks of smallest company size in the sample. Significantly, we observe that the return-risk relationship of the markets appears to be the outcome of investor concerns that apply on thresholds, rather than are continuously applied. In this view, the relationship between higher returns and higher betas is the outcome of thresholds of awareness of investors across levels of stock beta, company size, and stock liquidity. Although we find clear violations of the CAPM (e.g., the lowest beta portfolios do not have the lowest overall returns) there are clear consistencies and stabilities in the attributes of beta. The consistency of beta across its upside and downside components and the persistence of beta across extended bull and bear markets are both quite striking. It appears that a significant degree of market rationality, as encapsulated by beta, is implied by our findings.

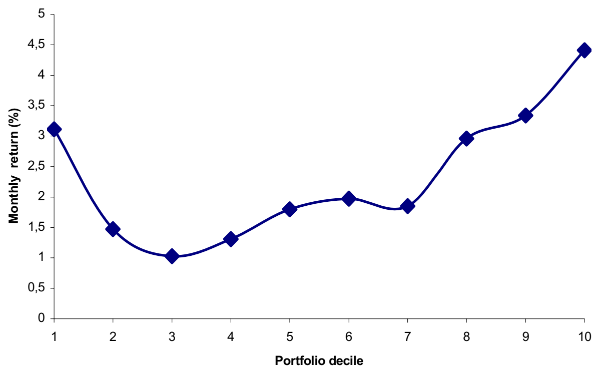

Fig. 1. Average portfolio returns as a function of beta for Australian stocks: 1974-2004

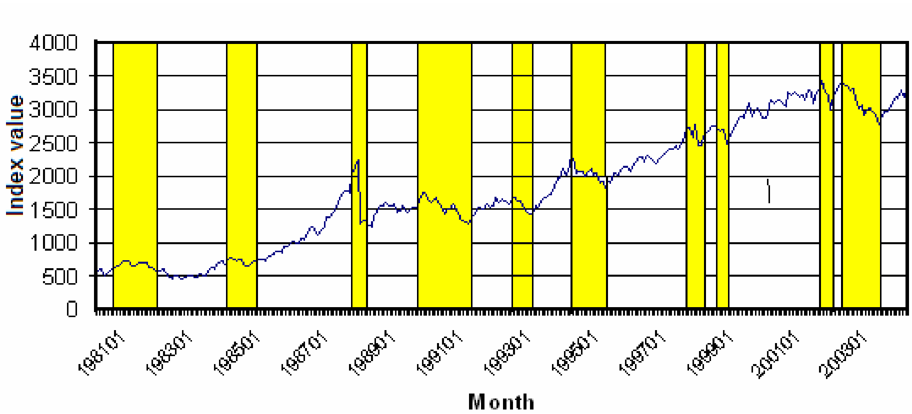

Fig. 2. All ordinaries index: bear markets – January 1980 to December 2003

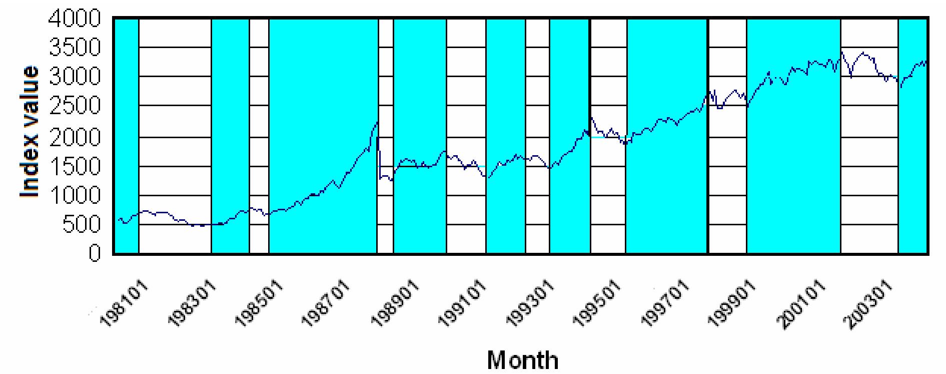

Fig. 3. All ordinaries index: bull markets – January 1980 to December 2003

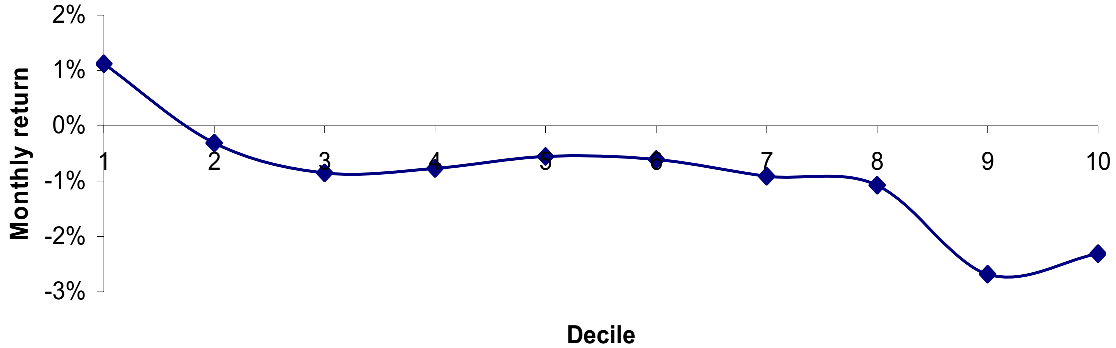

Fig. 4. Portfolio returns with increasing beta decile in bear markets

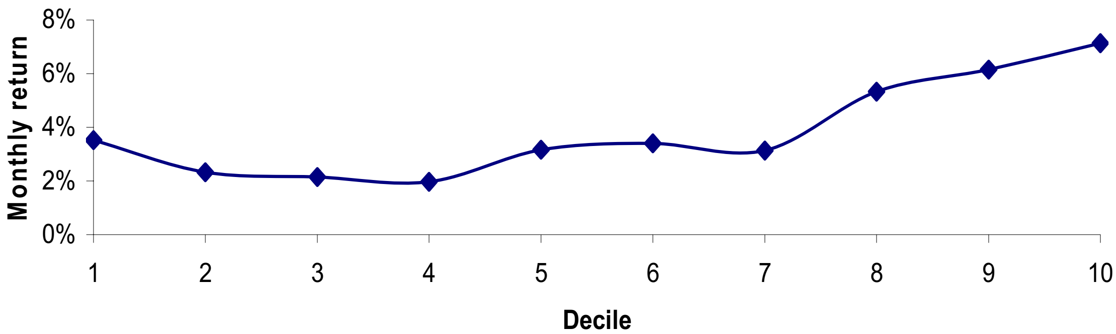

Fig. 5. Portfolio returns with increasing beta decile in bull markets

Table 1. Descriptive statistics

	Dataset 1	Dataset 2
Total monthly observations	265,535	190,218
Maximum observations in one month	1,085	1,048
Minimum observations in any one month	552	192
Total number of companies	2,635	2,347
Total number of months in sample	312	288
Maximum observations in any portfolio decile	108	104
Minimum observations in any portfolio decile	55	19
Average company size (million)	$394	$398

Note: Dataset 1 is the dataset used in calculating the results for Figures 1, 4 and 5 and Tables 2-3 and 6-7. Dataset 2 is the culled dataset used to calculate the results in Tables 8 and 9.

Table 2. Stocks sorted by β

Portfolio	Return	β	β^{-}	β^{+}
1 Low β	3.1 %	-0.9	-1.0	-0.1
2	1.5	0.2	0.3	0.0
3	1.0	0.4	0.5	0.2
4	1.3	0.5	0.7	0.4
5	1.8	0.7	0.8	0.6
6	2.0	0.9	1.0	0.8
7	1.8	1.2	1.2	1.0
8	3.0	1.5	1.4	1.4
9	3.3	2.0	1.7	1.9
10 High β	4.4	3.2	1.8	4.0

Note: This table presents the equally-weighted average returns of stocks sorted by β. For each month, we calculate β with respect to the market of all stocks listed on the Australian Stock Exchange using monthly discrete returns, using data available for the previous 60 months. We rank stocks into deciles (1-10) and form equal-weighted portfolios at the beginning of each month. The number of stocks in each portfolio varies across time from 55 to 108. The columns labeled β^{-} and β^{+} report the average of equal-weighted individual stock betas for the portfolios, calculated over market downturns and market upturns, respectively. The column labeled "Return" reports the monthly average time-series excess portfolio return over the sample period. The sample period is from January 1974 to December 2004.

Table 3. Stocks sorted by β^{-}

Portfolio	β^{-}	β	β^{+}
1 Low β^{-}	-2.4	-0.05	1.0
2	-0.2	0.6	0.7
3	0.2	0.7	0.7
4	0.45	0.8	0.8
5	0.7	0.9	0.9
6	0.9	1.0	1.0
7	1.2	1.2	1.2
8	1.5	1.5	1.5
9	2.0	1.75	1.6
10 High β^{-}	3.5	1.9	2.0

Note: For each month, we calculate β^{-} as for β in Table 2 and rank stocks into deciles (1-10) and form equal-weighted portfolios at the beginning of each month. The columns labeled β and β^{+} report the time-series average of equal-weighted individual stock betas over the holding period for the portfolios formed on β^{-}. The sample period is from January 1974 to December 2004.

Table 4. Bear markets and average monthly declines

	Start	Finish	Period (months)	XAO	Average monthly decline
1	1980:11	1982:02	17	-37%	-2.2%
2	1984:04	1984:05	2	-13.3%	-6.7%
3	1987:09	1988:02	6	-44.3%	-7.4%
4	1989:09	1991:01	17	-23.7%	-1.4%
5	1992:05	1992:10	6	-15.0%	-2.5%
6	1994:01	1995:01	13	-20.7%	-1.6%
7	1997:07	1997:10	4	-10.0%	-2.5%
8	1998:04	1998:08	5	-10.1%	-2.0%
9	2000:06	2000:10	5	-16.4%	-3.3%
10	2001:01	2003:03	27	-13.4%	-0.5%

Note: This table presents the periods of the 10 bear markets used in the analysis along with the total XAO index decline (recomputed on a monthly basis).

Table 5. Bull markets and average monthly increases

	Start	Finish	Period (months)	XAO	Average monthly increase
1	1980:01	1980:11	11	25.2%	2.3%
2	1982:07	1983:12	18	66.7%	3.7%
3	1984:06	1987:09	40	241.1%	6.0%
4	1988:03	1989:08	18	24.6%	1.4%
5	1991:01	1992:05	17	27.0%	1.6%
6	1992:11	1994:01	15	59.6%	4.0%
7	1995:02	1997:09	32	44.1%	1.4%
8	1998:09	2001:06	34	32.4%	1.0%
9	2003:03	2003:12	10	16.0%	1.6%

Note: This table presents the periods of the 9 bull markets used in the analysis along with the total XAO index increase (recomputed on a monthly basis).

Table 6. Average monthly changes and betas across bear markets

Decile	Average EW return	Average beta
1	0.9%	-0.8
2	-0.75%	0.2
3	-1.7%	0.4
4	-1.6%	0.55
5	-1.8%	0.7
6	-1.7%	0.9
7	-1.8%	1.1
8	-2.5%	1.5
9	-3.9%	1.9
10	-3.5%	3.1

Note: At the outset of each of the bear markets in Table 4, we form equally-weighted portfolios by partitioning stocks by their beta (calculated as for Figure 1), and calculate the portfolio return with no rebalancing. The figures in the table are formed by averaging the betas and the portfolio returns across each bear market on a monthly basis.

Table 7. Average monthly changes and betas across bull markets

Decile	Average EW return	Average beta
1	3.5%	-0.9
2	2.3%	0.2
3	2.15%	0.4
4	2.0%	0.6
5	3.2%	0.7
6	3.4%	0.9
7	3.1%	1.2
8	5.3%	1.5
9	6.15%	2.0
10	7.1%	3.2

Note: As for Table 6, at the outset of each of the bull markets in Table 5, we form equally-weighted portfolios by partitioning stocks by their beta (calculated as for Figure 1), and calculate the portfolio return with no rebalancing. The figures in the table are formed by averaging the betas and the portfolio returns across each bull market on a monthly basis.

Table 8. Average monthly returns for portfolios formed on beta with average portfolio market capitalizations and turnover liquidities

Decile	Beta	Return (%)	Company capitalization ($ million)	Turnover liquidity (%)
1 (low)	-0.3	1.9	60	1.9
2	0.2	1.7	145	1.5
3	0.4	1.2	222	1.6
4	0.6	1.2	366	1.7
5	0.7	1.4	625	2.1
6	0.9	1.4	670	2.3
7	1.1	1.3	629	2.65
8	1.4	1.5	375	3.25
9	1.85	1.7	219	3.7
10 (high)	2.6	1.5	69	4.6

Note: Portfolios formed on beta and average returns are calculated exactly as for Figure 1 (and Table 2). The difference here is that we use Dataset 2 on the right-hand side of Table 1, which is reduced due to constraints on data entry imposed by the need to calculate a stock's liquidity. For each portfolio (formed on beta) we calculate the average company market capitalization and turnover liquidity of the stocks in the portfolio. The portfolios are rebalanced monthly and the average of the betas, returns, company market capitalizations and liquidities for each portfolio are calculated as a time-series cross-sectional average.

Table 9. Return, company size and liquidity characteristics for Australian stocks as a function of beta

Beta	< 0.25	0.25-0.65	0.65-1.3	1.3-2.25	> 2.25
Percentage of sample (%)	15	20	30	20	15
Monthly excess equally-weighted return (%)	1.8	1.25	1.4	1.6	1.5
Median company size ($ million)	$75	$300	$650	$300	$75
Turnover liquidity	Medium 2%	Low 1.5%	Medium 2.25%	Medium-high 3.5%	High 4.5%

Note: The average betas of stocks were partitioned as in the first row of the table below. Within such partitions the average equally-weighted company return, average company size, and average liquidity are as presented in the final three rows.

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