The Significance of Beta for Australian Stock Returns

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ABSTRACT

Faff (2001) fails to find a statistically significant relation between returns and their beta in Australian markets. We discover, however, that betas of portfolios of Australian stocks have 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 firm size and liquidities, we show how beta appears to be rewarded - not continuously - but discretely across thresholds of firm size and stock liquidity. We conclude that beta remains relevant in the description of the risk-reward structure of asset pricing in Australian markets.

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1. Introduction

A quote attributed to Eugene Fama: "Beta as the sole variable explaining returns on stocks is dead" (New York times, February 18, 1992) has been widely disseminated as: "Beta is dead." However, the fact that the average returns of stocks might not accord with their beta as predicted by the CAPM, does not of itself negate the usefulness of beta as a measure of a stock's market risk exposure. If a stock's beta is stable across time, its beta – by definition - is a meaningful measure of its market exposure.

Over the period 1931-1991, Fisher Black (1993) (building on the Black, Jensen Scholes study of 1972) documents strong beta stationarity – leading to the observation that beta is "even more valuable if the line (of returns against beta) is flat." The stability of beta for U.S. stocks is also highlighted in the study by Grundy and Malkiel (1996) – who in an article entitled "Reports of Beta's Death have been Greatly Exaggerated," observe that portfolios of U.S. stocks formed on high-betas over the period 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.

Notwithstanding, Fama and French (1992, 1993, 1996, and elsewhere) argue that beta of itself is not an effective variable in explaining the cross-section of stock returns. Although portfolios comprising higher beta stocks tend to higher returns, the relationship effectively disappears once firm 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 CAPM is poor. Faff (2001) actually fails to find a statistically significant relation between beta and returns in Australian markets.

Against such findings, the present paper allows for a reappraisal of the relevance of beta in Australian markets. Our portfolio analysis approach is robust and allows for an assessment of stock returns across compartmentalized ranges of beta. We examine also how a stock's beta is constituted in terms of its "downside" (β^-) and "upside" (β^+) components (its beta as measured, respectively, over market downturns and upturns). Additionally, we examine the performances 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 with reference to the average firm size and liquidity of the stocks in the beta portfolios.

Our findings may be summarized as follows. Our portfolio betas are sufficiently stable as to be a meaningful measure of a portfolio's market risk exposure. Further, this stability is observed over market upturns and downturns, measured both as monthly variations and as prolonged "bull" and "bear" periods of the markets. For example, high beta stocks generally decline more than low beta stocks in bear markets and are thereby fundamentally more risky. Our observations of the explanatory nature of beta in relation to returns do not however apply continuously – or even monotonically. Rather, they apply discretely in relation to broad categories of the stock's firm size and liquidity.

Within such categories our results may in turn be summarized as follows. We find that stocks of larger firm size (> $500 million) dominate the middle range of beta (0.65 < beta < 1.3), while stocks of small/medium firm size ($150m < firm size < $500m) dominate both somewhat lower and somewhat higher beta ranges (0.25 <

beta < 0.65 and 1.3 < beta < 2.0). And portfolio returns increase significantly across these three ranges of increasing beta. However, within each of these beta/size ranges, we find that returns are not overly sensitive to their beta. Stocks of the very smallest firm sizes (firm size < $150m) predominate the extremely low and extremely high beta ranges (beta < 0.25 and beta > 2.0). We observe that stocks of the lowest beta have abnormally high returns, which leads to an overall "hockey-stick" return-beta relationship. These stocks however are characterized by very low trading volumes, which limit the practical opportunity to arbitrage. The stocks of very high beta with very high returns are also typically of the lowest firm size. However, these stocks typically have high liquidity.

We conclude that beta should not be written off either as a meaningful measure of an asset's market sensitivity, or as an indicator of the structure of asset returns in relation to market performances.

The rest of the paper is arranged as follows. In section 2, we outline the data, measurements of variables, and the methodology. In section 3, we present the results for the performances of beta portfolios in three sub-sections. In sub-section (i) we present our results for portfolios formed on beta as well as our observations for the composition of the portfolio betas in terms of their separate sensitivities to market upturns and downturns. In sub-section (ii) we present our results for the performance of the portfolios formed on beta over designated "bull" and "bear" periods. In sub-section (iii) we present our results for the characteristic composition of the beta portfolios in terms of the average firm size and liquidity of their stocks. The final section summarises and concludes the paper.

2. Data, variables and methodology

(i) Data

We use data from the AGSM database of ordinary common stocks listed on the Australian Stock Exchange (ASX) to construct portfolios of stocks. The data set initially held 450,489 monthly price observations from 3,922 firms 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 valid date or appearing as duplicate records). In order to calculate a stock's monthly return, we required that a security trade in the previous month, and in order to calculate the beta for such month, we required that a security trade in 35 out of the previous 60 months. This left a total of 265,535 monthly stock observations for analysis commencing January 1st, 1979. The descriptive statistics of our sample are presented in the central column of Table 1.

From the SIRCA database, we acquired daily trading volumes. These were aggregated to give monthly trading volumes for 279,663 observations. Using the AGSM security code and month this data was matched to the observation from the AGSM database. This created 190,218 monthly matched observations of monthly stock returns, stock firm size and stock liquidity. The average market capitalisation of the reduced sample was $398 million over 2,347 firms (which compares with $349 million over 2,635 firms for the original data set) – which implies that it is the stocks of smallest market capitalisation that have been removed. Notwithstanding, the range of firm sizes remained between $27,000 and $46 billion.

(ii) Measurement of variables

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

(a) *Measurement of stock returns ($r_{i,t}$)*

Returns ($r_{i,t}$) are measured as the difference between the closing price at the end of month t and the closing price at the end of month $t-1$: $r_{i,t} = (p_{i,t} - p_{i,t-1})/p_{i,t}$, where $p_{i,t}$ is the price of the stock at the end of month t. By associating a portfolio's return with the month after the portfolios is formed we seek to eliminate the bias that results from correlations in measurements, such as high volatility and higher returns. Returns are excess returns with the risk-free rate proxied as the three-month Treasury bill rate.

(b) *Measurement of stock betas* ($\beta_{i,t}$)

Beta ($\beta_{i,t}$) for each security 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, 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.

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:

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

where μ_M denotes the median monthly market return r_M for the period.

(c) *Measurement of stock firm size*

Size at the end of each month t is measured as the market capitalization of each stock. That is, the number of shares outstanding times the share price at the end of the month.

(d) *Measurement of stock liquidity*

Liquidity is variously defined in the literature.[1] Here, following both Datar, Naik and Radcliffe (1998) and Chan and Faff (2003) for Australian data, we use share turnover as a proxy for liquidity, and 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]

(iii) 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 these ends, at the beginning of each month, stocks *i* are ranked on 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

[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 illiquidity; 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.

portfolio return over the period (1979 to 2004). This allowed for as assessment of average stock returns as a function of their beta over the period.

For each portfolio, we also calculated the upside and downside betas of the stocks in the portfolios. This allowed for an assessment of the formation of the betas of stocks in terms of sensitivities to separate upturns and downturns in the market. The approach for forming portfolios based on beta was repeated by forming portfolios based on the downside beta of the stocks. This serves to confirm the formation of the betas of stocks in terms of constituent upside and downside components.

In order to investigate more fully the nature of cross-sectional returns and asset betas, we considered the performance of Australian stocks over periods of significant increases and declines. As for the Grundy and Malkiel (1996) study, 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 were 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 securities 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 firm size and liquidity characteristics of the beta portfolios. To achieve this, the average firm size and liquidity for each stock of each beta portfolio were measured at each monthly portfolio formation, and the average value assigned to the portfolio. We are thereby able to assign characteristic firm sizes and stock liquidities to the beta portfolios. This allowed us to assess the beta portfolios in terms of their average firm size and stock liquidities.

3. Results

Our results have essentially three components. Firstly, the relationship of returns against 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. Secondly, the meaningfulness of return-beta relationships in the context of pronounced and protracted "bull" and "bear" markets. Thirdly, 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 firm size and liquidity. We discuss each of these components below.

(i) The performance of Australian stocks as a function of beta

Figure 1 and Table 2 display the overall return performance of the portfolios of Australian stocks against their beta (β) over the period 1979 to 2004. We observe that portfolios 1 and 2 with the very lowest betas outperform portfolios 3 to 7 with higher betas. The relationship between portfolio returns and their betas is therefore non linear. 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 market indices to such extent that it is anticipated that the stocks of these portfolios must clearly be of the smaller firms in the data set. We note that returns do not differ substantially across portfolios 5 – 7 for the beta range approximately 0.6 to 1.3. Otherwise, portfolio returns appear to increase generally with beta when the two very low beta portfolios (1 and 2) are excluded.

The high returns observed for both the very low and very high beta portfolios prompts us to ask how the stocks of such portfolios perform during periods of market downturns. If the betas for the stocks of the portfolios are stable 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 performances of the very lowest beta portfolios are 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. By definitions of upside and downside betas, the data set of return observations is effectively partitioned between the measurements of β^{-} and β^{+}. 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.

A formation of portfolios on β^{-} implies that the portfolios are formed fully independent of the return observations needed to calculate β^{+}. Following the same procedure as for conventional betas (β), we created decile portfolios for downside betas (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 conclude that beta is a meaningfully stable measure of an asset's bearing of market risk exposure.

(ii) The performance of Australian stocks as a function of beta over periods of distinctive market bull and bear runs.

The observed stability of average portfolio betas across market upturn and downturns suggests the possibility that portfolios formed on beta are exposed - not just to incremental monthly market changes - but also to market "bull" and "bear" markets as a function of 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 in 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 – "Black Tuesday", the 20th of October. In similar manner, we consider "bull" markets as increases of 10% or more from trough to peak. Figure 3 and Table 5 similarly display the characteristic of each bull market. We notice that prior to the 'October 87 crash', the All Ordinaries index (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. We note, particularly, that portfolios 1 and 2 of lowest (negative) beta stocks actually go 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 overall while outperforming the portfolios of moderately low betas stocks as in Figure 1). Portfolios 8 – 10 for the higher beta stocks follow the market increasingly down with portfolio beta. Notwithstanding, we observe a distinct plateau return-beta relationship for the broad range of beta portfolios 3 – 7 with betas in the range approximately 0.3 to 1.3.

Figure 5 (and Table 7) displays the performances of portfolios ranked on beta for market upturns. We note, that the returns for the very lowest beta portfolios 1 and 2 again are anomalously high considering their low beta. At the ether end, the high beta portfolios 8 to 10 outperform the market at an increasing function of their beta – which more than compensates for their underperformance in market downturns (as in Figure 4) as revealed overall in Figure 1. Again, as in Figure 4 for the downturn market, and for the market overall as in Figure 1, a flat relationship of returns with beta persists for the middle range of beta portfolios 5 – 7 with betas in the range approximately 0.65 to 1.3.

(iii) The performance of Australian stocks with allowance for firm 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 firm 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 firm size and level of trading activity of the beta portfolios.

The need for a liquidity measurement led to the deletion of approximately 20% of the observations. The deletion of less consistently traded stocks acts as a robustness check on our findings. The elimination of less consistently traded stocks eliminates the very high portfolio returns in Figure 1. The results are presented in Table 8. The revised data set presents a new complexion on the data. It is indeed salutary to observe here how observations of asset pricing performances are impacted by the inclusion of stocks that - due to their small firm 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 firm size of the portfolios appears to be distributed roughly symmetrically about the middle beta portfolios (5-7). If we compartmentalise stocks as “large,” “medium” or “small” sized firms, a number of generalisations present themselves. These are summarised in Table 9, and discussed briefly below:

(a) *Stocks of large firm size (> $500 million equity capitalisation)*

These stocks are characterised as having betas in the range 0.65 to 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).

(b) *Stocks of medium firm size ($150-$500 million equity capitalisation)*

These stocks dominate both the beta range 0.25 to 0.65 *and* the beta range 1.3 to 2.0. 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 lower beta range (0.25-0.65) on average have returns that are markedly less than the returns of the stocks in the higher beta range (1.2-2.0). Further, the returns of the stocks of the largest firms ((a) above) - with betas mid-way between the betas of the two sets of medium-sized stocks - on average have returns falling between the returns for the two sets of medium-sized stocks.

(c) *Stocks of the smallest firms (< $60 million equity)*

These stocks dominate both the very low beta (< 0.25) and very high beta (> 2.0) ranges. The returns for stocks in both these ranges appear to be about as high as the returns for the stocks of medium sized firms in the beta range 1.3-2.0.

(d) *Portfolio performance and liquidity*

Finally, we observe also that if we exclude the small size firms 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 generally - and Chan and Faff (2003) for Australian data - reports a *negative* relationship between stock returns and the liquidity measure used here. It is possible, however, to hypothesis how this direction of causality might become reversed - that stocks might acquire higher liquidity *because* they are performing well, rather than that their returns are an outcome of their high liquidity. However, when we include the small size firms with betas less than 0.25, the returns to liquidity relationship is obscured. In this case, our findings are more consistent with Anderson, Clarkson, and Moran (1997) who fail to find a strong relationship between liquidity and size in the Australian market.

3. Conclusion

The study has investigated the association between stock returns and beta for Australian equities over the period 1974 to 2004. We have adopted a portfolio approach which relates average returns of portfolio stocks to the average betas of the stocks. We have observed the extent to which calculations of equally-weighted returns on an explanatory variable such as beta may be impacted dramatically by the contribution of the stocks of smallest firm size in the sample. It appears that the return-risk relationship of markets responds to investors' concerns that are broadly partitioned, rather than continuously applied. Thus the relationship between higher returns and higher betas is the outcome of thresholds of awareness of investors across levels of stock beta, firm size, and stock liquidity. Although we find clear violations of the CAPM (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.

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Figure1: Average portfolio returns as a function of beta for Australian stocks: 1974-2004

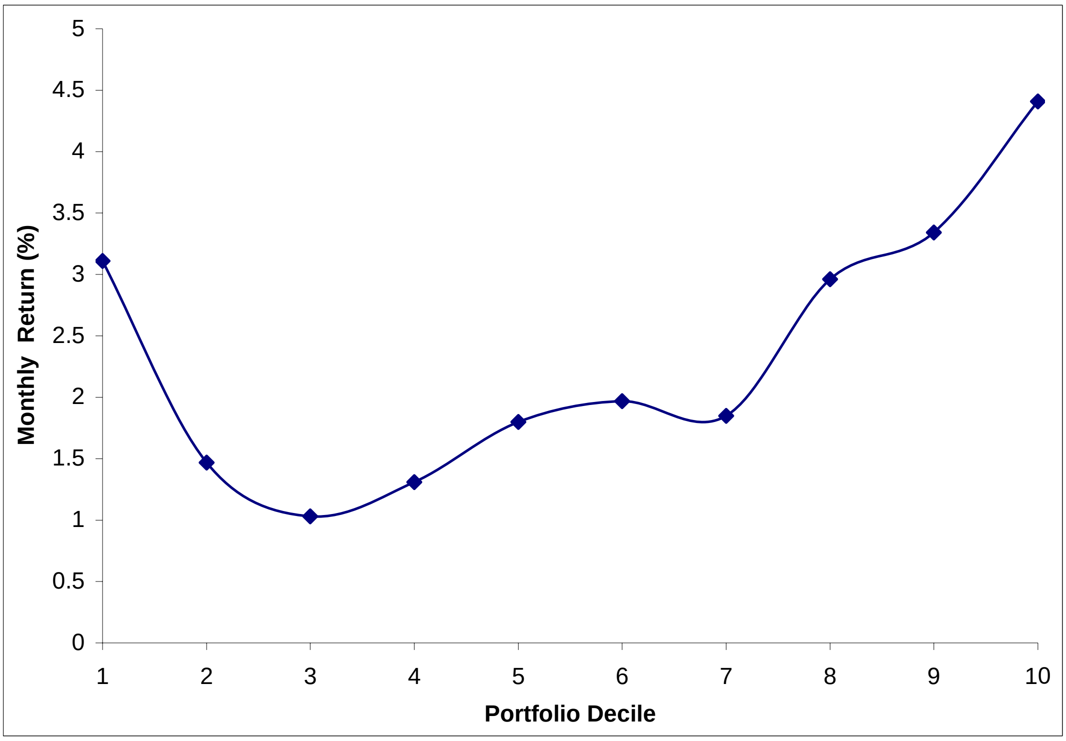

Figure 2: All Ordinaries Index: Bear Markets – January 1980 to December 2003.

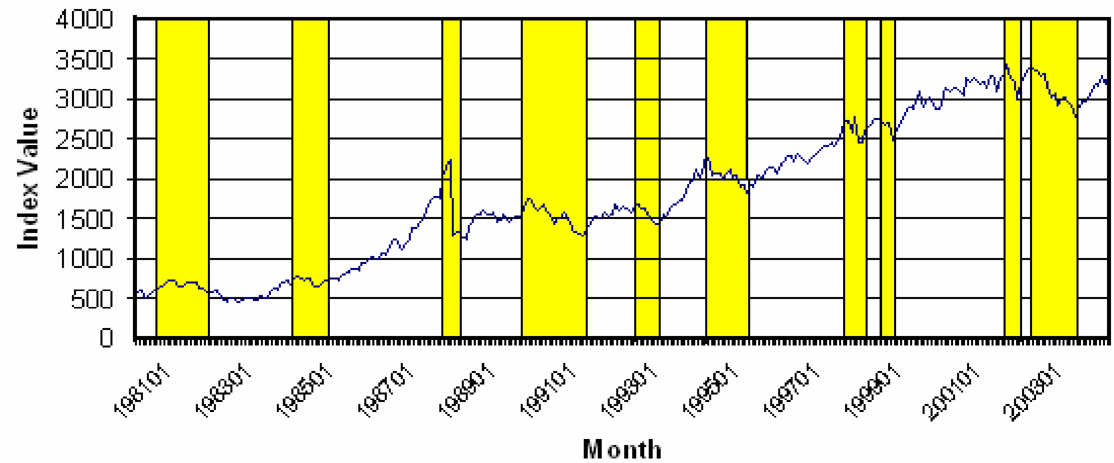

Figure 3: All Ordinaries Index: Bull Markets – January 1980 to December 2003.

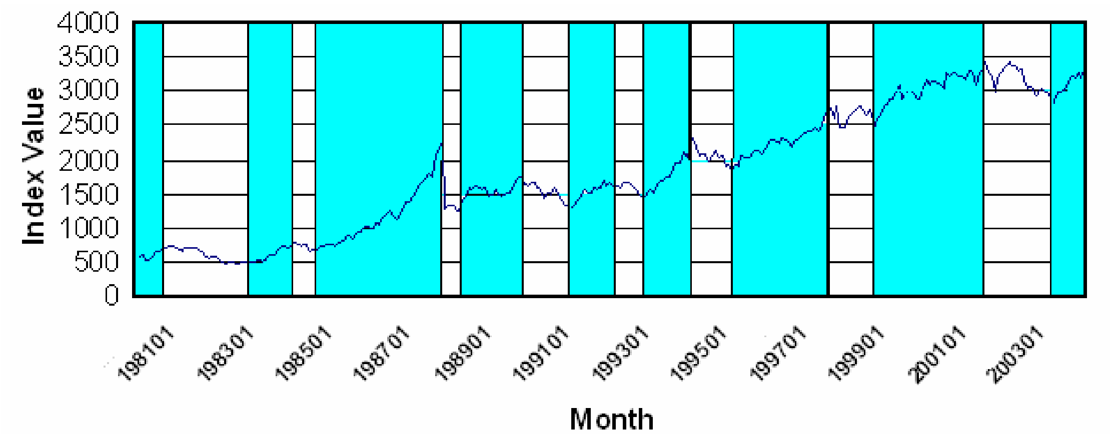

Figure 4: Portfolio Returns in Bear Markets.

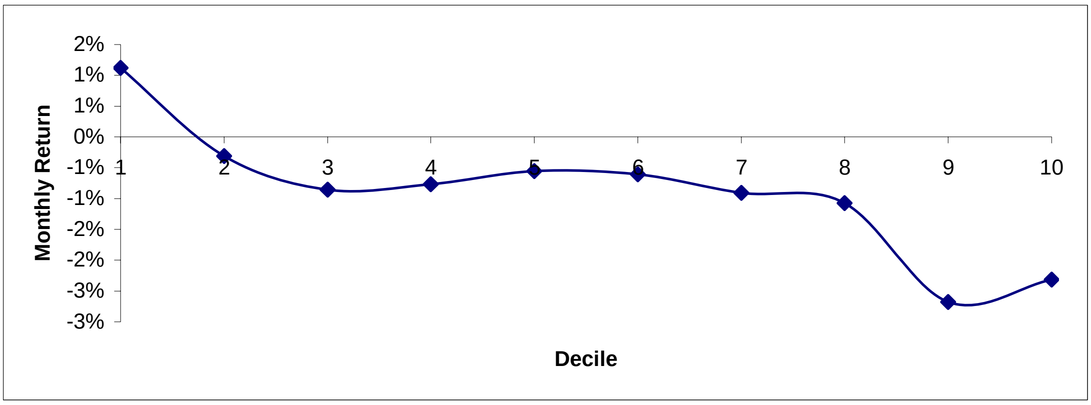

Figure 5: Portfolio Returns During Bull Markets.

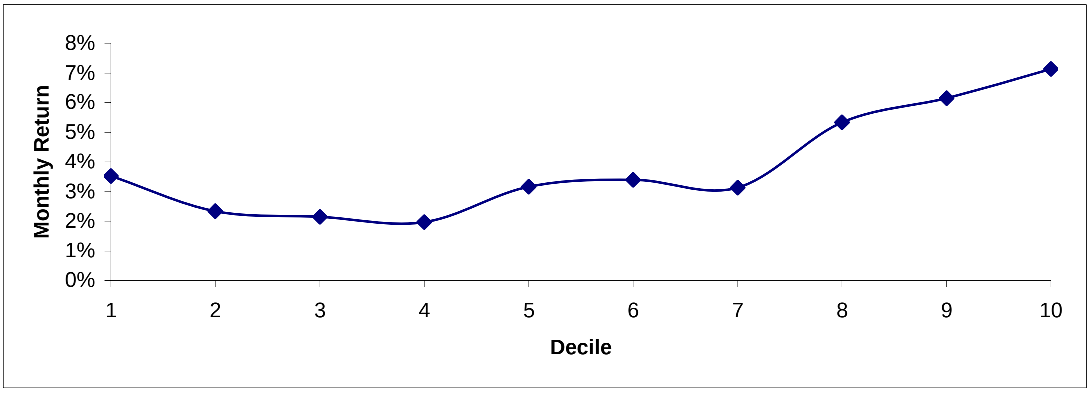

Table 1: Descriptive Statistics

	Observations referenced to beta	Observations referenced to beta, firm size and liquidity
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 firms	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 firm size (million)	$394	$398

Table 2: Stocks sorted by β

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 stocks. The columns labelled β^- and β^+ report the average of equal-weighted individual stock betas for the portfolios, calculated, respectively, over market downturn and market upturn months. The column labelled 'Return' reports the monthly average time-series excess portfolio return over the sample period. The sample period is from January 1974 to December 2004.

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

Table 3: Stocks sorted by β^-

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 labelled 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.

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

Table 4: Bear Markets and Average Monthly Declines

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

	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%

Table 5: Bull Markets and Average Monthly Increases

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

	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%

Table 6: Average Monthly Changes and Betas

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

	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

Table 7: Average Monthly Changes and Betas

As for table 6, at the outset of each of the market bull runs in Table 5, we form equally-weighted portfolios by partitioning stocks on 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 market bull run on a monthly basis.

	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

Table 8: Average monthly returns for portfolios formed on beta with calculated equally–weighted average portfolio market capitalisations and liquidities

Portfolios are formed on beta and average returns are calculated exactly as for Figure 1 (and Table 2) with the "full" data set (central column of Table 1). The difference here is that we have used the reduced data set of the right-hand side of Table 1, which is reduced due to constrains on data entry imposed by the need to calculate a stock's liquidity. For each portfolio (formed on beta) we calculated the average asset firm size and liquidity. The portfolios were rebalanced monthly and the average of the betas, returns, firm market capitalisations and liquidities for each portfolio is calculated as a time-series cross-sectional average (as Figure 1 and Table 2).

Decile	Beta	Return (%)	Firm capitalisation ($ million)	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

Table 9

The average betas of stocks were partitioned as in the first row of the table. Within such partitions the average firm return, firm size, and liquidity are as presented in the final three rows.

Return, firm 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 – 2.0	> 2.0
Annualised Return (%)	1.8	1.25	1.4	1.6	1.5
Size ($ million)	< $150	$150 - $500	> $500	$150 - $500	< $150
Liquidity (monthly volume of trades to shares outstanding)	medium 2%	low 1.5%	medium 2.25%	medium-high 3.5%	high 4.5%