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The sharemarket performance of Australian venture capital-backed and non-venture capital-backed IPOs

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Abstract

We assess the initial underpricing and long-run share performance of venture capital (VC)-backed IPOs. We find, as expected, that estimates of underpricing are less severe using Habib and Ljungqvist [Economics Letters 61 (1998) 381] inspired measures that more accurately estimate the true wealth loss to the entrepreneur. However, we find no statistically significant difference in the underpricing of VC backed and non-VC backed IPOs. Further, unlike Lee et al. [Journal of Banking and Finance 20 (1996) 1189], we find that Australian IPOs do not underperform in the after-market. Non-VC capital-backed and VC-backed firms earn normal returns in the 2 years following listing. Our results are inconsistent with the hypothesis that VC-backed IPOs are certified as high quality by mere virtue of being backed by venture capitalists.
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1. Introduction

Venture capital (hereafter VC), that is, pre-IPO equity capital provided by professional investors who actively monitor managers, is attracting widespread interest as an asset class. For instance, PricewaterhouseCoopers (2000) documents that VC investment in Australia more than doubled in a year, being $A473 million in 1998 and $A971 million in 1999. The

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same study reports comparable growth in the US and Europe. Given that a common exit strategy for venture capitalists is an IPO, the sharemarket performance of VC-backed IPOs is of considerable interest.

In the first systematic examination of the sharemarket performance of VC-backed IPOs in Australia, we investigate their initial day underpricing and long-run performance in the after-market and compare the performance of non-VC-backed IPOs. Initial-day underpricing is estimated using both the classic "headline" measure of underpricing, i.e., percentage increase of the last sale on first trading day over the issue price, and Habib and Ljungqvist (1998) inspired measures that estimate the total wealth loss to the entrepreneur. Assessments of long-run sharemarket performance are notoriously difficult to estimate accurately. We adopt a multi-pronged approach and estimate long-run performance using a zero–one market model with several different proxies for the market portfolio as well as a Fama and French (1993) three-factor model. Our approach closely follows Brav and Gompers' (1997) analysis of the long-run performance of US VC-backed and non-VC-backed IPOs.

Our research contributes in the following ways. Our research design tests, in a different market,[1] Habib and Ljungqvist's (1999) finding that VC-backed IPOs in the US do not experience less underpricing, once a control for the true wealth loss to the entrepreneur is introduced. This finding refutes Megginson and Weiss's (1991) conclusion that VC-backed IPOs experience less underpricing because of the quality certification function performed by VC backing. Our research design also tests the robustness of Brav and Gompers (1997) conclusion that VC-backed IPOs do not underperform in the long-run, in contrast to the smallest non-VC-backed IPOs. Further, we test the robustness in Australia of their accompanying finding that underperformance is not an IPO effect but one specific to small firms with a low book-to-market ratio. These tests of robustness are particularly significant given Lee et al. (1996) evidence that Australian industrial IPOs exhibit severe under-performance in the long run.

The rest of the paper is structured as follows. Section 2 shows how our research fits the literature on IPO underpricing and long-run performance. Section 3 describes the data collection procedures and research method. Section 4 details and discusses the results while Section 5 summarises and concludes the paper.

2. VC-backed IPOs: theory and evidence

2.1. Underpricing

The classical definition of underpricing is the percent difference between the closing market price on the first day of trading and the initial offer price. Rock (1986), among

[1] The Australian venture capital market is regarded as being less mature than in the US, see PricewaterhouseCoopers (2000). Accordingly, Australian venture capitalists, being less experienced in the IPO process than their US counterparts, may be less able to fully price an IPO. Australian procedures for issuing new equity also differ from those adopted in the US. These differences, and their implications for IPO underpricing, are discussed in Lee et al. (1996, pp. 1192–1194).

others, posits that this "headline" underpricing occurs to compensate uninformed outside investors for the risk that they will end up with the less successful IPOs.

Headline underpricing is arguably a concern for entrepreneurs since it reduces the dollars per share they receive from undertaking the IPO. However, Habib and Ljungqvist (1998) argue that entrepreneurs only care about headline underpricing to the extent that it affects their net wealth. They will only undertake costly action, such as hiring more reputable underwriters (see Carter and Manaster, 1990) to reduce headline underpricing, if the marginal benefit outweighs the cost. In general, entrepreneurs have greater incentives to reduce headline underpricing the higher the proportion of their company they sell.

The Habib and Ljungqvist (1998) argument implies a different reading of the evidence, in Barry et al. (1990) and Megginson and Weiss (1991), that VC-backed IPOs are less underpriced. Barry et al. and Megginson and Weiss cite their results as evidence that VC-backing certifies the quality of the IPO and this leads to less underpricing. However, Habib and Ljungqvist (1999) point out that the VC-backed firms in Megginson and Weiss's sample issued 36% more shares on average than did the non-VC backed firms, giving them greater incentive to undertake costly actions to reduce underpricing. They show that the VC-backed firms in Megginson and Weiss's sample suffered the same wealth loss as non-VC-backed firms once the differences in number of shares sold are considered. It is the actions undertaken by VC-backed IPOs to signal their quality rather than VC certification per se that reduces underpricing.

Habib and Ljungqvist's (1999) findings constitute a strong argument for revisiting Australian research on IPO underpricing. Lee et al. (1996) document that Australian IPO underpricing for industrial issues made between 1976 and 1989 varies in a manner consistent with Rock's model; however, they measure headline underpricing rather than wealth loss to the entrepreneur and do not control for VC presence. We address both issues in our research design.

2.2. IPO firms' long-run performance

In his landmark study, Ritter (1991) finds that in the 3 years after going public, IPO firms significantly underperformed a set of comparable firms matched by size and industry. He posits a "fads" phenomenon, whereby investors are unwarrantedly over-optimistic about the potential of firms, as a likely explanation. Loughran and Ritter (1995) investigate the long-run performance of both IPO firms and firms making seasoned equity offerings and document results that support Ritter's (1991) conclusion. They conclude that firms go public when equity values are high, and during these "windows of opportunity" equities are substantially overvalued.

Brav and Gompers (1997) examine whether the involvement of venture capitalists affects the long-run performance of IPO firms. Gompers (1995) shows that venture capitalists specialise in collecting and evaluating information in start-up and growth companies. However, if the market underestimates the importance of a venture capitalist in the pricing of new issues, long-run stock price performance may differ in line with differences in the size of venture capitalists' holdings. Brav and Gompers adopt the Fama and French three-factor model when estimating long-run returns. They find that although the VC-backed sample outperforms the non-VC-backed sample, the underperformance is

not an IPO effect. When issuing firms are matched to size and book-to-market portfolios that exclude all recent firms that have issued equity, IPOs do not underperform. Underperformance is a characteristic of small, low book-to-market firms regardless of whether they are, or are not, IPO firms.

Lee et al. (1996) provide Australian evidence on the post-listing performance of 266 industrial IPO firms made over the period January 1976 to December 1989. They calculate monthly cumulative buy-and-hold returns for their sample firms for up to 36 months after the listing month. They then subtract the return to the All Ordinaries Accumulation Index to obtain a cumulative buy-and-hold abnormal return (CBHAR) for each firm. They find the IPOs perform poorly in the first 3 years, with poor performance not confined to any year.[2] By month 36, the equal weighted CBHAR is -51.259%.[3] Lee et al. observe that the performance of this sample of IPOs is considerably worse than those in Ritter's study. The remarkably divergent findings in Lee et al. and Brav and Gompers (1997) prompt the question whether research design differences account for the divergences. It is notable that Lee et al.'s (1996) research design is not capable of showing whether underperformance is a phenomenon associated with small firms with low book-to-market ratios. Further, it might be that Lee et al.'s results are time-period specific. We address these issues in our research design.

3. Sample selection and research method

3.1. Sample selection

We identify 333 industrial IPOs on ASX from 1991 to 1999 inclusive, of which 38 are VC-backed IPOs.[4] Confirmation that each ostensible VC-backed IPO is correctly identified is done via inspection of prospectuses. If the prospectus shows that a venture capitalist was a director or a shareholder at the time the prospectus was issued then the firm is confirmed as VC backed. A venture capitalist is a firm or individual specialising in investing in unlisted equities. Venture capitalists are identified from the directory maintained by the Australian Venture Capital Association and by examination of the publicly available information on the major corporate shareholders in IPO firms. If the prospectus does not show such information then the firm's Company Secretary or Chief Financial Officer is asked to verify whether the firm was VC backed.

Share prices adjusted for dividends and changes in basis of quotation and market capitalisations for all firms listed on the exchange on a month end basis up to 1999 inclusive are sourced from Aspect Financial. Aspect Financial Historical book value data is also derived from the same source. However, Aspect Financial's book value data are

[2] How (2000, Table 4, pp. 109–110) shows that Australian natural resource IPOs made during the period 1979–1990, in contrast to industrials, do not exhibit significantly poor value-weighted performance in the 36 months subsequent to listing.

[3] Their results are robust to the method of weighting.

[4] We are grateful to Philip Lee of the University of Sydney for supplying the list of 333 IPOs and to Victor Bivell of *Australian Venture Capital Journal* for identifying 34 of the 38 VC-backed IPOs.

limited to firms still listed on ASX. The Signal G database[5] is used to collect missing values.

3.2. Underpricing measures

UPSTD=(Pc – Pi)/Pi, where Pc is the closing price on the first day of trading; Pi is the issue price. UPSTD is the traditional underpricing calculation, and is referred to as headline underpricing by Habib and Ljungqvist (1999).

The first variation of the traditional calculation is UPLI, the loss to the issuer.

UPLI=(1 – RO)(Pc – Pi)/Pi, where RO is the ownership portion of the firm retained.

UPLI shows the actual loss to the issuers per issued share. The next measure is UPLRMV, it is the underpricing loss standardised by market value of the firm.

UPLRMV=(Pc – Pi)(SecondaryShares + RO × PrimaryShares)/(Pc × TotalShares), where SecondaryShares is the number of shares held by pre-IPO shareholders that are sold in the IPO, PrimaryShares is the number of new shares offered in the IPO, and TotalShares is the total shares on issue for that firm after the IPO.

UPLRIP shows the loss standardised by the value of the firm based on the issue price.

=(Pc – Pi)(SecondaryShares + RO × PrimaryShares)/(Pi × TotalShares), where all terms are as previously defined.

The formulas developed above are calculated for each firm; means and medians are reported for whole sample, the non-VC-backed sample, and the VC-backed sample. A value-weighted measure of all the underpricing measure is also calculated:

$$\frac{\sum_i (\text{TotalShares}_i \times \text{UPX}_i)}{\sum_i \text{TotalShares}_i};$$

UPX_i is UPSTD or UPLI or UPLRMV or UPLRIP for IPO_i.

3.3. Underpricing: An example

The above measures of underpricing are illustrated with a numerical example. Suppose ABC has 1000 shares on issue prior to an IPO. The company has a public offer in which 1000 new shares and 500 existing shares are offered to the public at $1.00 per share. The first-day closing market price is $1.40 per share. UPSTD, using the definition above, is thus 40%. UPLI, which adjusts this "headline underpricing" measure for retained ownership (in this example, the original shareholders have retained 500 shares out of a total issued capital of 2000 shares, i.e., 25%), is thus 30%. UPLRMV, which is a measure of the wealth loss to the original shareholders divided by the market value of the firm after listing, is, as per the formula above, 10.7%. The wealth loss to the original shareholders consists of two parts. First, the original shareholders lost $0.40 per share on the 500 shares

[5] The Signal G database is an electronic version of all announcements made by firms listed on ASX.

they sold, i.e., $200. Second, the original shareholders bear a 25% share of the loss on the 1000 new shares that were sold at $1.00 instead of their "true" worth of $1.40 per share. This amounts to a further loss of $100. The total loss to the original holders is thus $300, and when this is expressed as a proportion of the market value of the firm after listing ($2800), UPLRMV is 10.7%. UPLRIP, scales the loss to the original shareholders ($300 as per the previous example) by the value the firm implied by the issue price (i.e., $2000). UPLRIP is thus $300/$2000 or 15%.

3.4. Long-run analysis—research method

The maximum period over which post-IPO performance is measured is 24 months, a choice determined by data availability constraints. Absent data constraints, we would have reviewed performance over 36 months, in line with other studies. However, other studies indicate that under-performance is well evident by the end of year two (e.g., Lee et al., 1996). Abnormal performance is estimated using excess return methods; and a Fama and French (1993) three-factor model.

3.4.1. Excess return methods

The excess return of each IPO is calculated for 24 months starting in the month after the stock has listed. The excess return is calculated in three ways on an equal and value-weighted basis: an index (Australian All Ordinaries Accumulation index) adjustment; a market value adjustment; and a book-to-market adjustment.

3.4.1.1. Equal weighted return calculation. Returns are defined as CBHARs, where the starting price for each company is its last price in the month of listing. The buy-and-hold return for every month up to month 24 is calculated for each IPO. The cumulative buy-and-hold abnormal return (CBHAR) is calculated by subtracting the control's return: the index; market value quintiles; and book-to-market quintiles. The return on a control is calculated in the same way as the IPO. Once the CBHAR has been calculated for each security, an average CBHAR is calculated for that month; this is done for all 24 months.

For the index control, the value that enters into the return calculation is the index itself. The value that is used for the return calculation of the market value and book-to-market value quintiles is the average adjusted share return of the quintile that the IPO fits, on the basis of market value or book-to-market value.

3.4.2. Quintile formation

The market value and book-to-market quintiles[6] are formed each month; and the average share price for each quintile is calculated. Market-value quintiles are formed by ranking all firms listed on ASX on the basis of market value. The same process is followed for the book-to-market quintile formation. The book-to-market ratio for each firm is calculated as the most recent preceding book value divided by the current market value.

[6] Lyon et al. (1999) suggest deciles for the American market. The Australian market is much smaller and so we use quintiles.

3.4.3. Significance tests

Student's t statistics are calculated for each monthly CBHAR. The BHAR for month n is calculated as $\mathrm{CBHAR}_n - \mathrm{CBHAR}_{n-1}$. Then the t statistic for the BHAR is calculated as follows:

$$t_{\mathrm{month}} = \frac{\mathrm{AverageBHAR}}{\sigma(\mathrm{BHAR})/\sqrt{n}}$$

where $\mathrm{AverageBHAR}_\tau$ is the sample mean of a month's BHAR, and σ(BHAR) is the cross-sectional sample standard deviation of abnormal returns for the sample of n firms.

The t statistic for a month n's CBHAR is

$$t_n = \frac{\sum_{n=0}^{n} t_{\mathrm{month}}}{\sqrt{n}}.$$

3.4.4. Value weighting

Value-weighted returns are calculated monthly. The first step is to calculate the market value of all IPOs monthly. Then a factor, f, is calculated for each IPO for month 1 as[7]

$$f = \frac{\mathrm{IPOmarketvalue}_{\mathrm{month1}}}{\mathrm{ControlValue}_{\mathrm{month1}}}.$$

The ControlValue for the index is the index number itself. In the market and book-to-market quintile calculations, the ControlValue is the market value of the quintile the IPO fits. This fixed factor, f, is then multiplied by the control value for that IPO for each of the 24 months, this yields 24 values (one per month) for each IPO ($f \times$ ControlValue). In the case of the market value and book-to-market value quintiles, each firm will have five f's calculated; this allows the IPO to switch quintiles monthly. Each month, all the IPOs' $f \times$ ControlValues are summed, giving $\Sigma(f \times \mathrm{ControlValues})$ for a month. The wealth relative is then calculated as the total market value of all IPOs in a month divided by $\Sigma(f \times \mathrm{ControlValues})$ for that month. The value-weighted return is then calculated by subtracting 1 from the wealth relative.

3.4.5. Treatment of delisting firms

There are 14 firms in this sample that were liquidated or went private before they reach their 24th month of listing on ASX. These 14 firms are from the sample of IPOs that list up to and including 1997. The following approach is adopted for the treatment of these delisting firms: the last recorded price of the delisting firm is assumed to be the cash return to the investor; this cash return is then held for the remaining months of the 24-month

[7] This factor can be thought of as the number of "shares" in the index (or market quintile or book-to-market quintile) that can be purchased, such that the value invested in the index is the same as the market capitalisation of the IPO. For example, suppose the market value of an IPO at the end of month 1 is $75 million, and that the index on that date is 1250.0. The factor f for this IPO is thus 75,000,000/1250= 60,000. Each month, the market value of the IPO is the numerator in the value weighed calculation, and the denominator is 60,000 times the actual index value for the corresponding month.

period. This approach assumes that the investor did in fact receive the stock price and no less; however, if the firm was liquidated the shareholder may have received less than the last price; and the subsequent returns of these delisting firms may be upwards biased.[8] Since the subsequent returns are probably upwards biased, no interest is added to the cash return.

IPOs that list in 1998 and 1999 do not have enough data to be compared beyond December 1999. Therefore, these firms have less than 24 months of returns. Since these firms have not delisted, they are not treated as delisting firms. The strategy taken is to allow these firms to drop out as their data runs out.

The approach adopted by prior literature (Ritter, 1991; Loughran and Ritter, 1995; Field, 1997; Brav and Gompers, 1997; Carter et al., 1998; Gompers and Lerner, 1999; Hamao et al., 2000; Doukas and Halit, 2000) is to exclude delisting firms from subsequent return analysis, and this approach is carried out to demonstrate the differences between the two methods.[9]

3.5. *Fama and French (1993) three-factor model*

Following Barber and Lyon (1997), an individual Fama and French regression is estimated for all the IPOs with more than 10 monthly returns (237 IPOs out of 333 fulfilled this requirement).[10] The regression is specified as follows:

$$R_{it} = \alpha_{it} + \beta_{it}\mathrm{RMRF}_t + \gamma_{it}\mathrm{SMB}_t + \delta_{it}\mathrm{HML}_t + \varepsilon_{it,} \qquad t = 1, 2, \ldots, T.$$

The dependent variable, R_{it}, is the monthly return (monthly return: $[P_t/P_{t-1} - 1]$) for an IPO less the corresponding 3-month treasury bill[11] (Monthly return—R_f). A significantly positive value for the intercept α indicates that after controlling for market, size, and book-to-market factors in returns, an IPO has performed better than expected. RMRF is the monthly value-weighted return of all the firms listed on ASX less the corresponding 3-month treasury bill rate; this is a proxy for the market risk factor in stock returns. SMB is the difference in the returns of a value-weighted portfolio of small stocks and big stocks; and is meant to mimic the risk factor in returns related to size. HML is the difference in the returns of a value-weighted portfolio[12] of high book-to-market stocks and low book-to-

[8] The bias is unlikely to be substantial because there are only 14 out of 333 IPOs that are delisted. Further, the last price for each IPO is assumed to held as cash, and is not reinvested in the index.

[9] Lee et al. (1996) adopt an alternative control for delisting bias. When a firm delists, investment of the final proceeds in the market index is assumed for subsequent periods; and where delisting occurs due to bankruptcy or other forms of financial distress, the full loss of the investment is recorded.

[10] This methodology is not the same as in Brav and Gompers (1997). Brav and Gompers run Fama and French regressions on groups of their whole sample. Their purpose is to isolate the source of underperformance in IPOs. Our aim is to determine whether the abnormal performance documented in the excess return analysis also appears in three-factor regression analysis.

[11] The use of the 3-month treasury note is recommended by Lyon et al. (1999).

[12] To calculate the value-weighted monthly return for a portfolio in month n: determine the stocks comprising that portfolio using $\mathrm{month}_{(n-1)}$ prices; record the market value of the portfolio in $\mathrm{month}_{(n-1)}$ and in month_n. Calculate the cumulative monthly return of the portfolio. Use the following formula to calculate the return: $[(P_n/P_{(n-1)}) - 1]$.

Table 1
Number of IPO firms by industry group, and related percentages in parenthesis, for the 333 Australian IPOs included in the study, with comparable statistics for the 295 non-VC-backed firms and the 38 VC-backed firms

Industry	Sample composition		
	Whole sample	Non-VC backed	VC backed
Services	137 (41%)	118 (40%)	19 (50%)
Construction and Development	51 (15%)	45 (15%)	6 (16%)
Retail/Consumer/Household	45 (14%)	39 (13%)	6 (16%)
Financial	31 (9%)	31 (11%)	0 (0%)
Industrials	69 (21%)	62 (21%)	7 (18%)
Total number of firms	333	295	38

market stocks; and is meant to mimic the risk factor in returns related to the book-to-market ratio. These two factors were created by following the process outlined by Fama and French (1993).[13]

Pooled regressions are also run. The purpose is to determine whether the presence of VC backing makes any difference. Four regressions are reported in Results and discussion. Regression 1 is a Fama and French regression of all 237 IPOs' returns; regression 2 is the same except there is a dummy variable for the presence of a venture capitalist. For completeness, a separate Fama and French regression is run for all 207 non-VC-backed IPOs (regression 3); and all 30 VC-backed IPOs (regression 4). All regressions are generalised method of moment (GMM) regressions; and all regressions are Newey and West (1987) adjusted to correct for autocorrelation and heteroscedasticity.

4. Results and discussion

4.1. Descriptive statistics

Table 1 shows the industry groups that the firms belong to and how many firms in that industry are VC backed. The majority of firms in the VC-backed and non-VC-backed samples are in the services industry. The significance tests indicate there are no statistically

[13] Each month, all firms listed on ASX are ranked according to market value (ME) as at the end of the previous month; the median firm is then used to split the stocks into two groups: small (S) and big (B). Similarly, each month all firms are ranked according to book-to-market equity (BE/ME). Book value is defined as book value of shareholders' equity. Stocks are then broken into three BE/ME groups based on break points. Negative book value firms are excluded when defining the breakpoints for BE/ME: bottom 30% (Low); middle 40% (Medium); top 30% (High). From the intersection of the two ME and three BE/ME groups, six portfolios are constructed: S/L, S/M, S/H, B/L, B/M, B/H. For example, the portfolio S/L contains all firms with the attributes of S and L; this means that all the firms in that portfolio will be in the Small ME group and the Low BE/ME group. Then monthly value-weighted returns are calculated. Finally, the SMB portfolio is created monthly by taking the difference, each month, between the simple average of the returns on the three small-stock portfolios (S/L, S/M, and S/H) and the simple average of the returns on the three big-stock portfolios (B/L, B/M, and B/H). The monthly portfolio HML is the difference between the simple average of the returns on the two high-BE/ME portfolios (S/H and B/H) and the simple average of the returns on the two low-BE/ME portfolios (S/L and B/L).

Table 2
Descriptive statistics for the 333 Australian IPOs included in the study (Panel A), with comparable statistics for the 295 non-VC-backed firms (Panel B), the 38 VC-backed firms (Panel C) and significance tests for differences between the non-VC-backed and VC-backed firms (Panel D)

Variable	Total assets ($A)[a]	Years of operation	Retained ownership
(Panel A) Whole sample			
Mean	645,990,000	7	49.63%
Median	25,088,000	10	54.30%
(Panel B) Non-VC backed			
Mean	723,550,000	7	48.93%
Median	24,638,828	10	53.90%
(Panel C) VC backed			
Mean	43,889,292	7	55.10%
Median	29,952,500	9	59.35%
(Panel D) Differences between samples			
t-stat for difference between means	− 1.32	− 0.21	0.69
$Pr > \|t\|$	0.1884	0.8346	0.4882
Wilcoxon statistic	6402	6568	7047
Wilcoxon *Z*	0.0994	0.4164	1.2558
Wilcoxon *Z*'s *t* prob	0.9209	0.6774	0.2101

[a] Dollar values have not been adjusted for inflation.

significant differences in the industries to which VC-backed and non-VC-backed IPOs belong. This suggests it is unlikely that industry related effects account for any differences in VC-backed firms' performance.

Table 2 summarises several firm characteristics. The whole sample has operated prior to the IPO for 7 years on average, and the median is 10 years; the median of the VC sample is 9 years whilst the non-VC-backed sample is 10 years. Significance tests reveal the null hypothesis that the means (medians) are equal cannot be rejected. Table 2 also shows that the non-VC-backed sample has total assets of $724 million on average, with a median of $24.6 million. The VC-backed sample has average total assets of $43.9 million on average, and a median of $30.0 million. Notwithstanding the large difference in means,[14] significance tests indicate the null hypothesis that the two samples are drawn from the same size distribution cannot be rejected.

Assuming that statistically insignificant differences in age and size of total assets are also economically insignificant, these results are noteworthy because they suggest that, in Australia at least, venture capitalists do not take firms public at an earlier stage that non-VC-backed firms, as found by Megginson and Weiss (1991) in the US. Differences in maturity may therefore be discounted as an explanation for observed differences in market performance.

[14] There are two extreme values within the sample, relating to the privatisation of Telstra and the Commonwealth Bank of Australia. These two securities cause the value-weighted performance measure reported in the subsequent results to be extreme. Accordingly, we also refer to the results for value weighting when these two securities are excluded.

More intriguingly, Table 2 shows that retained ownership is marginally higher for the VC-backed group. Across the whole sample, the proportion of equity retained by the issuers is 49.63% on average, and the median is 54.30%. The non-VC-backed sample has average retained ownership of 48.93% and a median of 53.90%. The VC-backed group has average retained ownership of 55.10%, and a median of 59.35%. The significance tests indicate the null hypothesis cannot be rejected; however, this finding differs from that documented for the sample of firms studied in Megginson and Weiss (1991). As noted earlier, Habib and Ljungqvist (1999) find that the VC-backed firms in Megginson and Weiss' sample issued 36% more shares on average than did the non-VC-backed IPOs and they argue that the sale of a higher proportion of their equity provided the VC-backed firms with greater incentives to take action to decrease headline underpricing. Habib and Ljungqvist's argument implies that we should not expect to observe significantly different headline underpricing between VC-backed and non-VC-backed IPOs because the proportion of retained ownership is about the same across the two groups.

4.2. Underpricing

Table 3 is a correlation coefficient matrix of the four underpricing calculations. It shows that all the measures of underpricing are highly correlated. Correlation coefficient matrices (not reported) for the non-VC-backed and VC-backed samples exhibit similar relationships.

Table 4 displays summary statistics for the different underpricing measures. The non-VC-backed sample has average standard underpricing (UPSTD) underpricing of 24.49% and a median of 12.00%. The VC-backed sample has average underpricing of 33.07% and a median of 14.00%. Considering the means, it appears that the VC-backed sample experienced higher underpricing; however, statistical tests in panel D indicate no significant difference between either the means or medians. Interestingly, the value-weighted standard underpricing calculation reveals a remarkably close level of underpricing across the samples; 28.14% for the non-VC-backed sample, and 28.75% for the VC-backed sample.

Table 3
Whole sample correlation coefficients (and associated probabilities) for various definitions of underpricing for the 333 Australian IPOs included in the study

	UPSTD[a]	UPLI[a]	UPLRMV[a]	UPLRIP[a]
UPSTD[a]	1	0.75204	0.39551	0.48375
		< 0.0001	< 0.0001	< 0.0001
UPLI[a]		1	0.78472	0.90393
			< 0.0001	< 0.0001
UPLRMV[a]			1	0.88677
				< 0.0001
UPLRIP[a]				1

[a] The underpricing measures are: UPSTD=(Pc – Pi)/Pi, where Pc is the closing price on the first day of trading; Pi is the issue price. UPLI=(1 – RO)(Pc – Pi)/Pi, where RO is the retained ownership. UPLRMV=(1 – RO)((Pc – Pi)/Pc)((SharesIssued)/TotalShares), where SharesIssued is the number of new (i.e., primary) shares offered in the IPO, and TotalShares is the total shares on issue for that firm after the IPO. UPLRIP=(1 – RO)((Pc – Pi)/Pi)(SharesIssued/TotalShares).

Table 4
Whole sample underpricing calculations (and associated probabilities) and subcategories of VC and non-VC backed for various definitions of underpricing for the 333 Australian IPOs included in the study

Statistic	UPSTD[a]	UPLI[a]	UPLRMV[a]	UPLRIP[a]
(Panel A) Whole sample				
Mean	25.47%	9.68%	2.82%	4.88%
Median	12.00%	4.92%	1.66%	1.93%
t-stat different from zero	9.38	9.12	7.52	6.42
Pr > | *t* |	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Value-weighted calculation	28.17%	9.39%	2.41%	3.87%
(Panel B) Non-VC backed				
Mean	24.49%	9.89%	2.94%	5.15%
Median	12.00%	4.92%	1.77%	2.04%
t-stat different from zero	8.90	8.39	7.04	6.05
Pr > | *t* |	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Value-weighted calculation	28.14%	9.49%	2.46%	3.95%
(Panel C) VC backed				
Mean	33.07%	8.01%	1.88%	2.76%
Median	14.00%	5.47%	1.23%	1.46%
t-stat different from zero	3.14	4.91	3.85	4.13
Pr > | *t* |	0.34%	< 0.0001	0.05%	0.02%
Value-weighted calculation	28.75%	7.39%	1.45%	2.24%
(Panel D) Sample differences				
t-stat for difference between means	− 1.00	0.56	0.90	1.00
Pr > | *t* |	0.3159	0.5740	0.3680	0.3179
Wilcoxon	6721	6467	6052.5	6122.5
Wilcoxon *Z*	0.6706	0.2157	− 0.5246	− 0.3993
Wilcoxon *Z*'s *t* prob	0.5025	0.8293	0.6002	0.6900

[a] The underpricing measures are: UPSTD=(Pc − Pi)/Pi, where Pc is the closing price on the first day of trading; Pi is the issue price. UPLI=(1 − RO)(Pc − Pi)/Pi, where RO is the retained ownership. UPLRMV=(1 − RO)((Pc − Pi)/Pc)((SharesIssued)/TotalShares), where SharesIssued is the number of new (i.e., primary) shares offered in the IPO, and TotalShares is the total shares on issue for that firm after the IPO. UPLRIP=(1 − RO)((Pc − Pi)/Pi)(SharesIssued/TotalShares).

This set of results is consistent with Habib and Ljungqvist's (1999) hypothesis that firms with the same level of retained ownership will display about the same level of underpricing.

Given that level of retained ownership and headline underpricing is about the same across the two groups, it is not surprising that the underpricing measure capturing only the loss to the issuer (UPLI) also reveals no significant difference across the VC-backed and non-VC backed firms. The non-VC-backed sample has a mean of 9.89% and a median of 4.92%. The VC-backed sample has a mean of 8.01% and a median of 5.47%. Note that while the differences are not significant in our sample firms, the average wealth loss suffered by the entrepreneurs in the VC-backed firms is less than that suffered by the entrepreneurs in the non-VC-backed firms. However, the headline underpricing calculations would indicate that it is the VC-backed firms that suffer the greater losses. This comparison demonstrates the importance of calculating wealth loss rather than headline underpricing. Another salutary point demonstrated by these figures is that there is a large

difference between underpricing reported in terms of headline underpricing and that reported in terms of wealth loss to the entrepreneur. Accordingly, studies that use headline underpricing in estimating the cost of going public may well have overstated this cost.

UPLRMV is the underpricing measure that takes into account primary and secondary share sales in the IPO and that standardises the loss to the issuer by the closing day market value. The whole sample has an average UPLRMV of 2.82% and a median of 1.66%. The non-VC-backed sample has an average of 2.94%, and a median of 1.77%. The VC-backed sample has a mean of 1.88% and a median of 1.23%. Again, tests of significance reveal no difference in the loss to the VC-backed IPOs and non-VC-backed IPOs.

For completeness, we also report UPLRIP, the underpricing loss calculated by reference to the value of the firm's outstanding shares valued at their issue price. The whole sample has an average UPLRIP of 4.88% and a median of 1.93%. The non-VC-backed sample has an average of 5.15%, and a median of 2.04%. The VC-backed sample has a mean of 2.76% and a median of 1.46%. The differences are not statistically significant.

4.2.1. Summary

The underpricing results are supportive of Habib and Ljungqvist (1999), who suggest that the traditional underpricing calculation may not represent the true wealth losses suffered by the issuer. Although our samples of VC-backed and non-VC-backed firms experienced about the same level of underpricing, the results illustrate the potential for dramatically different estimates of underpricing to emerge depending on whether headline underpricing is calculated or other measures are calculated that take into account the wealth loss suffered by the entrepreneur. Habib and Ljungqvist (1999) argue that wealth loss measures are more appropriate since it is the potential wealth loss they may suffer that prompts entrepreneurs (and the venture capitalists who back them) to engage in costly action to reduce headline underpricing.

4.3. Long-run stock price performance

Table 5 displays the returns at the 24th month for the samples of IPOs.[15] Table 5 also shows the results generated when returns are calculated including delisting firm returns, and excluding delisting firm returns. Only the former are discussed, though both calculations produce essentially the same inferences.

The mean monthly equal weighted CBHAR against the index rises to 6.13% (insignificant) in month 12 (though this result is not reported) and then drops to −2.16% (insignificant) by month 24. At the same time, the value-weighted CBHAR rises strongly to 44.11% in month 12, and 112.09% by month 24. However, the large value-weighted returns are largely due to the inclusion of Telstra and CBA. When these two securities are removed from the value-weighted returns the month 24 CBHAR is 32.69%. Since the equal weighted returns rise and then fall, and the value-weighted returns continue to rise, we may infer that small firms performed less well than larger firms in the 24 month subsequent to listing.

[15] We also computed monthly returns for each of the 24 months, though these are not reported. We do however refer to some of these results. The monthly returns are available on request to the corresponding author.

Table 5
Two-year abnormal returns using various benchmarks for the 333 Australian IPOs included in the study, including and excluding the effect of firms that delisted using both equal weights and value-weighted returns, and comparable statistics for the 295 non-VC-backed firms and the 38 VC-backed firms

Benchmark	Delisting firm return held			Delisting firms excluded		
	CBHAR	*t*	VCBHAR	CBHAR	*t*	VCBHAR
Whole sample						
Index	− 2.16%	− 0.244	112.09%	− 0.80%	− 0.034	101.31%
Market value quintiles	13.12%	1.819*	85.71%	13.87%	1.881*	87.02%
Book-to-market quintiles	13.56%	1.796*	92.38%	13.80%	1.806*	86.18%
Non-VC-backed sample						
Index	2.23%	0.354	117.61%	3.69%	0.587	106.11%
Market value quintiles	17.64%	2.245**	91.73%	18.41%	2.292**	93.13%
Book-to-market quintiles	16.34%	2.045**	90.03%	17.99%	2.179**	94.76%
VC-backed sample						
Index	− 31.47%	− 1.875*	− 7.80%	− 29.81%	− 1.764*	− 8.23%
Market value quintiles	− 17.15%	− 0.849	− 28.90%	− 15.46%	− 0.762	− 28.71%
Book-to-market quintiles	− 12.02%	− 0.521	− 41.28%	− 13.99%	− 0.577	− 40.85%

CBHAR: equal weighted cumulative buy-and-hold abnormal return.
VCBHAR: value-weighted cumulative buy-and-hold abnormal return.
t: two-tailed *t* statistic of significance.
* *t* equal to 10% but not greater than 5%.
** *t* equal to 5% but not greater than 2%.

We now consider long-run returns for the whole sample when market value quintiles are used as the control. The mean equal weighted CBHAR rises to 12.45% (significant at 5%) by month 12 (not reported) and finishes at 13.12% (significant at 10%) by month 24. The value-weighted CBHAR rises to 39.87% by month 12 and 85.71% by month 24. These very large returns are primarily due to the inclusion of Telstra and CBA. When the returns for Telstra and CBA are excluded, the month 24 market value quintile adjusted CBHAR is 6.08%.

Table 5 also shows the whole sample's monthly returns against book-to-market quintiles. The mean equal weighted CBHAR rises to 12.45% (significant at 1%, not reported) by month 12, and 13.56% (significant at 10%) by month 24. The value-weighted CBHAR moves to 4.48% in month 12 and then to 92.38% in month 24. When Telstra and the CBA are removed the value-weighted CBHAR at month 24 is 7.50%.

In sum, these results show that controlling for market value and book-to-market increases the equal weighted returns and reduces the value-weighted returns and thus provides further evidence on the sensitivity of long-run return measures to differences in computation. The results are consistent with Loughran and Ritter's (1995) conclusion that underperformance is not a characteristic of IPOs per se but more likely due to IPO firms being small and having low book-to-market values. Further, a comparison of the stock price performance of our IPOs with the abnormally poor stock price performance of the Australian IPOs from Lee et al. (1996) suggests that the long-run under-performance of IPO firms in the aftermarket may well be time dependent.

Splitting the sample into a VC-backed sample and a non-VC-backed sample does yield some different results. It must be remembered that the non-VC-backed sample comprises 295 firms and is therefore much larger than the VC-backed sample of just 38 firms. Because the non-VC-backed sample is so large, it performs in a similar manner to the whole sample. The month-by-month returns for the non-VC-backed group compared to the three benchmarks (i.e., the index, market value quintiles, and book-to-market quintiles) reveal movements and magnitudes that are very similar to the whole sample.

The 24-month equal weighted CBHAR for the non-VC-backed group against the: index is 2.23% (insignificant); market value-based quintiles is 17.64% (significant at the 5% level); book-to-market based quintiles is 16.34% (significant at the 5% level). The value-weighted results show essentially the same result as the whole sample. The 24-month value-weighted CBHAR against the: index is 117.61% (excluding Telstra and CBA this is 35.74%); market value based quintiles is 91.73% (excluding Telstra and CBA this is 8.82%); book-to-market based quintiles is 90.03% (excluding Telstra and CBA this is 3.34%). Again, we may infer from these results that the smaller stocks perform worse than the larger stocks.

The results for the VC-backed portfolio suggest that the portfolio performs relatively poorly against all three benchmarks, though the standard errors are large because the sample size is quite small. It is also worth noting that these results are based on a single-control benchmark, and hence ignore the possibility that more than one factor is priced in the long-run performance of IPO firms. Monthly returns of the VC-backed sample against the index, market value quintiles, and book-to-market quintiles, all display a gradual decline in CBHARs during the 24-month period. The 24-month equal weighted cumulative buy-and-hold abnormal return against the: index is -31.47% (significant at 10%); market value size based quintiles is -17.15% (insignificant); book-to-market based quintiles is -12.02% (insignificant). The 24-month value-weighted cumulative buy-and-hold abnormal return against the: index is -7.80%; market value-based quintiles is -28.90%; book-to-market based quintiles is -41.28%. Even though these results suggest that the VC underperformance is statistically insignificant, one cannot deny that if an investor took a strategy, over the period 1991–1999, of investing solely in VC-backed stocks then that investor would have earned a negative average return over 24 months.

The value and equal weighted results of the VC-backed group display a perplexing result. Intriguingly, the equal weighted CBHAR against the index is more negative than the value-weighted return; suggesting that the small firms are dragging the equal weighted return down. However, the equal weighted CBHARs against the market value and book-to-market quintiles are more negative than the value-weighted returns; this suggests that the large firms are performing worse than the smaller firms. Brav and Gompers (1997) observe a similar result; when they value-weighted their returns: the returns against the indexes they used showed that the poor performance of the sample resided with the smaller firms because the value-weighted wealth relatives were higher than the equal weighted wealth relatives. However, after value weighting the wealth relative that controlled for size and book-to-market, the wealth relative fell. The seeming paradoxes in these results provides a justification for considering performance using a method that simultaneously accounts for all three factors; and these Fama and French regression results are presented below.

Table 6
Statistical tests of differences in the means and medians for 2-year CBHAR (using various benchmarks) for the 295 non-VC-backed and the 38 VC-backed Australian IPOs included in the study

Benchmark	*t* value	*p* value	Wilcoxon stat	*Z*	*p* value
Index	1.40	0.1634	2239	− 1.9587	0.0515
Market value quintiles	1.19	0.2344	2334	− 1.5931	0.1127
Book-to-market quintiles	1.41	0.1613	2141	− 2.2964	0.0227

Table 6 reports parametric and nonparametric tests for differences of the means and medians, respectively, for the 24-month CBHAR. The parametric test for the difference between the means of the VC-backed sample and the non-VC-backed sample reveals insignificant *t* statistics of: 1.40 with an associated probability of 0.1634 against the index; 1.19 with an associated probability of 0.2344 against the market value based quintiles; 1.41 with an associated probability of 0.1613 against the book-to-market based quintiles. According to the parametric results, the null hypothesis that the means are equal to zero cannot be rejected. However, the nonparametric Wilcoxon tests present a somewhat different picture, as the results are significant in the case of book-to-market quintile benchmarks. The Wilcoxon statistic for the index is 2239, with an associated *Z* statistic of − 1.9587, and a *t* probability of 0.0515. The Wilcoxon statistic for the market value based quintiles is 2334, with an associated *Z* statistic of − 1.5931, and a *t* probability of 0.1127. The two results are insignificant at conventional levels, though the probabilities are higher than the parametric probability values. In contrast, the Wilcoxon statistic for the book-to-market based quintiles is 2141 with an associated *Z* statistic of − 2.2964, and a *t* probability of 0.0227; and hence the null hypothesis can be rejected. It appears that there may be some difference in the 24-month equal weighted CBHARs between the VC-backed sample and the non-VC-backed sample, although the evidence is not conclusive. We move to the Fama and French three-factor controls before drawing any final conclusion.

As discussed in the methodology, the calculation of cumulative buy-and-hold abnormal returns differs to prior literature. If a firm delists, we assume that the last stock price is held as a cash return for the remaining months of the 24-month period. However, in prior literature once a firm delists, it is not included in subsequent cumulative abnormal return calculations. We disagree with that method; it results in the final 24-month cumulative buy-and-hold abnormal return not reflecting a strategy buying a portfolio of securities and holding that portfolio of securities for 24 months. Nevertheless, we carry out the method of excluding delisting firm returns report the results in Table 5. It appears that the result is different where more firms are delisting. In the whole sample, the 24-month CBHAR exclusive of delisting firm returns is − 0.80% as compared to − 2.16% for the 24 month CBHAR inclusive of delisting firm returns; this means that excluding delisting firms from a portfolio return upwardly biases the return because the poorer performing firms are excluded. In all cases, it is observed that calculating CBHARs exclusive of delisting firm returns upwardly biases the subsequent CBHARs.

Overall, there is consistent evidence that the whole sample and the non-VC-backed sample do not underperform. Even though the numerical result suggests that the VC-backed sample underperforms, the returns are frequently not significant, for the obvious reason that the standard errors are large, due to small sample sizes. At this stage, there is only weak

evidence that the 24-month CBHAR is significantly different for the VC and non-VC samples.

4.3.1. Fama and French regressions

Table 7 reports pooled Fama and French regressions. Regression 1 regresses all 237 IPOs' monthly returns. The intercept alpha is positive, suggesting slight abnormal performance, but insignificant. The coefficient on the market factor is positive and significant with a t value of 2.83 and probability of 0.0047. The coefficient on the SMB factor is positive and highly significant with a t value of 4.39 and associated probability value less than 0.0001. The coefficient on the HML factor is positive, though insignificant. The results are therefore consistent with the proposition that there are at least two factors that are priced in the long-run returns of IPOs. While the adjusted R^2 of the regression is low at 0.48%, the Wald statistic of 23.78 (with an associated probability of less than 0.0001) means that the overall regression model is highly significant.

Regression 2 includes a dummy variable for the presence of a VC-backed firm, and is run on the same set of firms as regression 1. The significance and magnitude of the standard

Table 7
Pooled Fama and French Regressions for all 237 IPO firms with sufficient data (regression 1 and 2) and 207 non-VC-backed firms (regression 3) and 30 VC-backed firms (regression 4)

Regression	1	2	3	4
Observations	5673	5673	4961	712
Alpha estimate	0.0045	0.0051	0.0057	−0.0045
T	1.43	1.51	1.69	−0.54
p value	0.1522	0.1299	0.0908	0.5904
Beta estimate	0.1521	0.1531	0.1581	0.1271
T	2.83	2.84	2.74	0.84
p value	0.0047	0.0045	0.0062	0.4004
Gamma estimate	0.2577	0.2576	0.2165	0.5436
T	4.39	4.39	3.61	2.59
p value	<0.0001	<0.0001	0.0003	0.0099
Delta estimate	0.0304	0.0299	0.0117	0.1939
T	0.69	0.68	0.27	0.99
p value	0.4912	0.4990	0.7856	0.3248
VCDummy		−0.0046		
T		−0.64		
p value		0.5215		
R^2	0.0053	0.0054	0.0037	0.0285
Adj R^2	0.0048	0.0047	0.0031	0.0244
Wald	23.78	25.83	18.63	6.72
Wald p value	<0.0001	<0.0001	0.0003	0.0814

The regression is estimated using generalised method of moments; and all regression statistics are Newey and West (1987) adjusted to correct for autocorrelation and heteroscedasticity. The estimated regression equation (for regressions 1, 3 and 4) is

$$R_{it} = \alpha_{it} + \beta_{it}\mathrm{RMRF}_t + \gamma_{it}\mathrm{SMB}_t + \delta_{it}\mathrm{HML}_t + \varepsilon_{it,} \qquad t = 1, 2, \ldots, T.$$

The estimated regression equation for regression 2 is

$$R_{it} = \alpha_{it} + \beta_{it}\mathrm{RMRF}_t + \gamma_{it}\mathrm{SMB}_t + \delta_{it}\mathrm{HML}_t + \eta_{it}\mathrm{VCDummy}_t + \varepsilon_{it,} \qquad t = 1, 2, \ldots, T.$$

Table 8
Summary statistics for the 237 individual firm Fama and French regressions with sufficient data (Whole sample) and 207 non-VC-backed firms and 30 VC-backed firms

Statistic	Sample Type											
	Whole				Non-VC backed				VC backed			
	Alpha	Beta	SMB	HML	Alpha	Beta	SMB	HML	Alpha	Beta	SMB	HML
Mean	0.01	0.32	0.07	−0.05	0.01	0.37	0.02	−0.04	0.00	−0.05	0.37	−0.14
Median	0.00	0.21	0.02	−0.05	0.00	0.22	−0.02	−0.02	0.00	−0.15	0.22	−0.24
t statistic	1.50	2.62	0.87	−0.75	1.43	2.74	0.30	−0.49	0.42	−0.21	1.35	−1.00
Pr > | *t* |	0.14	0.01	0.38	0.45	0.15	0.01	0.77	0.62	0.68	0.84	0.19	0.32
Percentile												
100% Max	0.62	13.22	9.28	2.92	0.62	13.22	9.28	2.92	0.16	2.84	6.70	1.82
99%	0.23	9.10	3.32	2.67	0.23	9.10	3.09	2.67	0.16	2.84	6.70	1.82
95%	0.09	2.74	1.77	1.41	0.09	2.74	1.64	1.41	0.07	1.72	1.95	1.22
90%	0.05	1.62	1.26	0.90	0.05	1.66	1.14	0.92	0.05	1.41	1.67	0.77
75% Q3	0.03	0.73	0.45	0.37	0.03	0.71	0.44	0.37	0.03	0.82	0.78	0.36
50% Median	0.00	0.21	0.02	−0.05	0.00	0.22	−0.02	−0.02	0.00	−0.15	0.22	−0.24
25% Q1	−0.02	−0.49	−0.50	−0.39	−0.02	−0.46	−0.58	−0.37	−0.02	−0.73	−0.34	−0.73
10%	−0.05	−1.21	−1.12	−0.82	−0.05	−1.11	−1.12	−0.70	−0.07	−1.72	−1.07	−1.11
5%	−0.08	−1.73	−1.65	−1.23	−0.08	−1.51	−1.65	−1.23	−0.08	−2.04	−1.49	−1.17
1%	−0.10	−2.95	−2.26	−2.50	−0.10	−2.95	−2.26	−2.50	−0.08	−2.55	−2.15	−1.86
0% Min	−0.12	−6.30	−2.69	−8.94	−0.12	−6.30	−2.69	−8.94	−0.08	−2.55	−2.15	−1.86
Freq distribution of regressions												
Negative	116	101	117	124	101	85	105	107	15	16	12	17
Negative and Sig 5%	14	4	13	12	14	3	11	8	0	1	2	4
Negative and Sig 10%	23	9	22	22	21	8	20	16	2	1	2	6
Positive	121	136	120	113	106	122	102	100	15	14	18	13
Positive and Sig 5%	12	15	12	9	11	14	9	9	1	1	3	0
Positive and Sig 10%	20	23	19	18	17	20	16	18	3	3	3	0
Adj R^2 neg	144				125				19			
Adj R^2 pos	93				82				11			
Adj R^2 pos > 10%	57				50				7			
Adj R^2 pos > 20%	32				26				6			
Wald												
Wald Prob < 0.0001	26				21				5			
Wald Prob < 5%	78				68				10			
Wald Prob < 10%	94				81				13			
Number of regressions	237				207				30			

Fama and French factors are mostly unchanged. The intercept alpha is positive, suggesting slight abnormal performance, but insignificant. The adjusted R^2 of the regression is again quite low at 0.47%. The coefficient on the venture capitalist dummy variable is negative and insignificant; and thus suggests that in a Fama and French framework, the long-run performance of VC- and non-VC-backed firms are statistically indistinguishable. Again, the Wald statistic is high at 25.83 with a probability less than 0.0001.

Regression 3 includes the monthly returns of the 207 non-VC-backed sample. The intercept is positive and significant (with a probability of 0.0454 for a one-tailed test), indicating evidence of abnormally positive aftermarket returns for the non-VC-backed firms. The coefficient on the market factor is positive and significant with a t value of 2.74 and probability of 0.0062, and the coefficient on the SMB factor is positive and highly significant with a t value of 3.61 and associated probability value of 0.0003. Again, the coefficient on the HML factor is positive and insignificant. Once again, the results suggest that there are at least two factors that are priced in long-run returns. Overall, regression 3 provides some evidence of significant positive abnormal performance for the non-VC-backed sample.

Regression 4 comprises the monthly returns for the 30 VC-backed firms. Interestingly, the intercept alpha is negative, indicating negative abnormal performance, but again the result is statistically insignificant. The coefficient on the market factor is positive, though insignificant. The coefficient on the SMB factor is positive and significant with a t value of 2.59 and associated probability value less than 0.0099. The coefficient on the HML factor is positive and insignificant. The adjusted R^2 of the regression is again low at 2.44%, and the Wald statistic of 6.72 (with a probability of 0.0814) means that the overall regression is insignificant. Overall, regression 4 displays no evidence of statistically significant abnormal performance for the VC-backed sample.

Table 8 provides the summary results for the 237 Fama and French regressions estimated for each firm. The whole sample has an average: alpha of 0.01 (insignificant), beta of 0.32 (significant at 1%), SMB coefficient of 0.07 (insignificant), and HML coefficient of -0.05 (insignificant). The results are similar for the non-VC-backed sample that has an average: alpha of 0.01 (insignificant); beta of 0.37 (significant at 1%); SMB coefficient of 0.02 (insignificant); HML coefficient of -0.04 (insignificant). The VC-backed sample's average coefficients are all insignificant. The VC-backed sample has an average: alpha of 0.00; beta of -0.05; SMB coefficient of 0.37; HML coefficient of -0.14.

Table 8 also displays the frequency distribution of the regressions. In the non-VC-backed sample (207 regressions): 101 regressions have negative alphas, of which 14 are significant at the 5% level, while 106 regressions have positive alphas, of which 11 are significant at the 5% level. The VC-backed sample, comprising 30 regressions has 15 negative alphas (none of which are significant at the 5% level) and 15 positive alphas, of which only one is significant at the 5% level. These results suggest that abnormal

Notes to Table 8:

The regression is estimated using generalised method of moments; and all regression statistics are Newey and West (1987) adjusted to correct for autocorrelation and heteroscedasticity. The estimated regression equation is

$$R_{it} = \alpha_{it} + \beta_{it}\mathrm{RMRF}_t + \gamma_{it}\mathrm{SMB}_t + \delta_{it}\mathrm{HML}_t + \varepsilon_{it}.$$

performance of the whole sample is limited to 26 firms (at the 5% level of significance): 14 exhibit negative abnormal performance, none of these are VC backed; and 12 exhibit positive abnormal performance, only one of which is VC backed. Only 32 firms of the 237 firms have R^2's greater than 20%, with six of these firms being VC backed. Finally, 78 firms have Wald probability values which are 5% or less, and 10 of these are VC backed.

Overall, the Fama and French regressions indicate slightly positive abnormal performance for the whole sample and the non-VC-backed sample, though the estimated alphas are generally insignificant.[16] Further, the results of the Fama and French regressions for the VC-backed IPOs are slightly negative, though they do not suggest statistically significant negative abnormal performance.

5. Summary and conclusion

This paper represents the first systematic examination of the sharemarket performance of VC-backed IPOs in Australia. We investigate the initial day underpricing and long-run performance of VC backed firms and compare this to the performance of non-VC-backed IPOs. Initial day underpricing is estimated using both the classic "headline" measure of underpricing, i.e., percentage increase of the last sale on first trading day over the issue price, and Habib and Ljungqvist (1998) inspired measures that estimate the total wealth loss to the entrepreneur.

Alternative underpricing calculations motivated by Habib and Ljungqvist (1999) indicate that the wealth loss suffered by the issuers of the VC-backed sample of IPOs is less, but not significantly, than the non-VC sample. However, the standard underpricing calculation would suggest that the VC-backed sample is more underpriced, although the difference is statistically insignificant. The general result from the underpricing experiments is inconclusive, about whether venture capitalists can certify firms and thereby reduce underpricing of those firms. We show that traditional or headline underpricing calculations for VC-backed and non-VC-backed IPOs are greatly in excess of the underpricing calculations based on the wealth loss to the original owners of the IPO. Accordingly, studies that use headline underpricing in estimating the cost of going public may well have overstated this cost.

Assessments of long-run sharemarket performance are notoriously difficult to estimate accurately. We adopt a multi-pronged approach and estimate long-run performance using a zero–one market model with several different proxies for the market portfolio (specifically, we use an index control, a size control and a book-to-market control) as well as a Fama and French (1993) three-factor model. Our approach closely follows Brav and Gompers' (1997) analysis of the long-run performance of US VC-backed and non-VC-backed IPOs.

The results of the equal weighted long-run analysis reveal that the sample as a whole did not underperform. VC firms have slightly negative risk-adjusted performance, though this is statistically insignificant. VC firms long-run performance is also shown to be not significantly different from the performance of non-VC backed firms. The performance of

[16] The exception is for a one-tailed test of the 207 non-VC-backed IPOs in regression 3 in Table 7.

the whole sample is thus consistent with efficient pricing of IPOs in the 2 years following listing. The results thus contrast the previously documented poor long-run performance of IPOs documented in the US and Australia. This suggests that the severe underperformance of Australian IPOs documented by Lee et al. (1996) is most probably sample specific. It is also possible that the US results in Ritter (1991) are in part explained by the specific time period from which he drew his sample.

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