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12 February 2018

The Underpricing of Venture Capital Backed IPOs in China

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December 2017

Abstract: This paper measures the influence of venture capital (VC) on IPO valuations in China. It is found that the authentication effect is dominated by the grandstanding effect, suggesting that VC firms in China greatly value their reputations. It is also shown that the market-specific characteristics of non-VC-backed firms are more closely related to their initial returns, compared to those of VC-backed firms. In addition, corporate fundamentals play a more important role in the valuation for VC-backed firms than for non-VC-backed firms.

Keywords: Venture Capital, IPO, Price Volatility.

JEL classification: G24.

[1] We would like to thank seminar participants at The Chinese University of Hong Kong and Fudan University for their helpful comments. We are also very much indebted to Sophia Lok, Vanessa Kwang, Jason Lo and Galvin Chia for their assistance in the research. Any remaining errors are ours. Corresponding author: Terence Tai-Leung Chong, Department of Economics, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong. Email: chong2064@cuhk.edu.hk. Tel: (852)39438193.

1. Introduction and Literature Review

1.1. Introduction

Studies on venture capital (VC) date back to the 1980s (Bygrave, 1987; Gorman and Sahlman, 1989). VC firms raise funds from institutional investors and individuals, and invest in start-ups. VC investors exit through initial public offerings (IPOs), mergers, management buyouts, or share buy-backs. As an intermediary between funds and start-ups, VC is widely believed to be a factor that accelerates research and development (R&D) and economic growth (Barry et al., 1990; Kortum and Lerner, 2000; Bottazzi and Da Rin, 2002). In China, the government has launched policies to regulate and promote such activities. In particular, the Chinese government provided guidance on the VC industry's development in 2000, implemented tax allowances for VC in 2007, and established a VC guiding fund of 40 billion RMB for emerging industries in 2015.

This paper aims to measure the influence of VC firms on IPO valuation in China. It differs from previous studies in that it conducts a broader analysis on VC-backed firms, and controls for more factors. It also attempts to identify the interactions of the "authentication agent effect" and "grandstanding effect" on the IPO underpricing of VC backed firms. Our paper contributes to the literature in two ways. First, we attempt to measure the influence of venture capital (VC) on IPO valuations in China. Taking IPO initial return and volatility as proxies for the degree of information asymmetry, this study adopts the time series regression methodology (Lowry et al., 2010) to control for firm-specific and market-wide factors. Second, as the biggest emerging market, China's capital market is worth studying and the results will have significant implications for other developing countries.

We find that VC firms in China are young and they greatly value reputation. The authentication effect is offset by firms' desire to build up their reputation. Further, our study shows that, compared to VC-backed firms, the market specific characteristics of non-VC-backed firms are more closely correlated

with their initial returns. Corporate fundamentals play a more important role in the valuation for VC-backed firms than for non-VC-backed firms.

The remainder of the paper is structured as follows. The next subsection reviews the literature. Section 2 describes some stylized facts of VC industry and IPO market in China. Section 3 defines the variables and describes the data employed in this study. Section 4 examines the role of VC firms in detail. Finally, Section 5 concludes the paper and offers several suggestions.

1.2. Literature Review

Our paper is related to several strands of literature. The first strand examines the comparative advantage of VC firms. Traditionally, financial intermediaries enjoy an advantage over average investors, in that they are more able to gather information on companies before financing them, and are better placed to monitor their activities after financing. VC firms have an edge over traditional financial intermediaries in dealing with information asymmetries, such as moral hazards and adverse selections by participating more actively in the management of firms they invest in. VC firms focus on start-ups with high uncertainty, rather than mature corporations – the latter of which are favored clients for banks. They intervene in start-ups through various means, such as serving as directors and monitors, acting as consultants, participating in recruitment, and assisting in external relations. As Kaplan and Strömberg (2003) describe, VC firms conduct due diligence and market analysis comprehensively before stepping into start-ups. These firms also employ numerous methods to reduce information asymmetries. Specific contractual provisions limit inherent risks, including the use of convertible bonds in financing contracts, staged financing, distribution of voting rights, or direct intervention in management (Gompers and Lerner, 1996; Hellmann, 1998). Hence, VC-backed start-ups show different characteristics compared to

their non-VC-backed counterparts, particularly in areas such as corporate governance and regulatory compliance (Chok and Sun, 2007; Krishnan et al., 2011).

Fried et al. (1998) show that board participation is more significant and extensive in VC-backed firms. Guo et al. (2004) note that VC improves the competitive power of biotechnology companies and lowers the cost of announcing information, thereby raising firm transparency through information disclosure. Clarysse et al. (2007) suggest that high-technology firms with VC backing are more inclined to appoint people with financial backgrounds as external board members. Guo and Jiang (2013) show that VC-backed firms outperform non-VC-backed firms in terms of profitability, labor productivity, sales growth and R&D investment. Townsend (2015) investigates how venture-backed companies are affected when other firms that share the same investor suffer a negative shock. He finds that the end of the technology bubble was associated with a larger decline in the chance of raising continuation financing for non-IT companies, in comparison to firms in other sectors.

Our study is also related to the literature on the underpricing of VC-backed firms. Compared to general investors, VC firms have skills and experience in selecting and valuing start-ups. They support the development of start-ups by offering management skills, financial strategies, and business relationships. These may influence the values of the enterprises they finance. A reduction in information asymmetries may reduce the tendency for VC-backed start-ups to be underpriced in their IPOs. The IPO underpricing phenomenon is widely studied and is believed to be a response to the complexity of valuation (Rock, 1986; Welch, 1992). Previous studies suggest that information asymmetry between issuers and investors makes it difficult for investors to identify the real value of corporations. Beattey and Ritter (1986) choose variables such as

issuing scale and ratio of retained earnings to represent degrees of uncertainty, and conclude that greater uncertainty leads to greater underpricing.

Other studies attempt to understand the role of VC firms in reducing the complexity of valuation. Sahlman (1990) shows that VC firms reduce the information asymmetry between investors and start-ups. Brav and Gompers (1997) argue that firms with VC backing experience less IPO underpricing than those without. VC firms put in significant effort, through measures such as due diligence, into seeking valuable enterprises and helping enterprises to realize their potential. These efforts may function as signals to the market, reducing uncertainty in valuation. In addition, VC-backed firms can directly influence pricing in the primary market via underwriters and investors. VC-backed firms tend to employ reputable underwriters, which also reduces underpricing (Megginson and Weiss, 1991).

The grandstanding effect (Gompers, 1996) suggests that VC firms tend to bring young firms to IPO with greater underpricing, in order to build up their reputations and their ability to attract additional funds in the future. Additionally, listed corporations can attract attention from the market by setting a low offering price, encouraging primary market investors to invest (Lee and Wahal, 2004), which also helps build the reputation of VC-backed firms. As a result, VC-backed firms may actually push for greater underpricing of IPOs. Chahine et al. (2007) found that while English VC firms act as effective authentication agents and reduce underpricing, the participation of VC firms in France led to more severe underpricing. This indicates that the grandstanding effect is quite large as VC firms in France are young and value reputation greatly.

2. The VC Industry and the IPO Market in China – Some Stylized Facts

2.1. The VC Industry in China

China's VC industry emerged in the late 1980s and has grown dramatically since 2005. According to China Venture Capital Annual Report 2015 published by Zero2IPO Research Center, in 2000, only 100 active VC firms existed. Five years later, this number increased to 500, and by 2015 had boomed further to over 8,000 firms. Total funds under management exceeded 600 billion US dollars. The number of new investments increased by 10 times over the last decade, reaching 3,626 by 2014. The dramatic growth of the VC industry during these years was partly due to support from policy makers, through new initiatives that encouraged private capital involvement, supported start-ups, and built multi-level capital markets.

The number of VC exits also boomed in recent years. A total of 830 exits occurred in 2014, growing from 100 in 2005. The first three quarters of 2015 alone saw 1,833 exits via IPOs, mergers, management buyouts, and buy-backs. IPOs are the most profitable and have been the most widely used exit strategy by VC firms over the last few years, followed by stock right transfers.

The A-share markets in China have become the central focus for Chinese enterprises, with 79.3% of IPOs taking place in A-share markets in 2015. Enterprises with VC backing tend to receive more funds from the domestic market over time. As such, we only focus on the firms listed on A-share markets in this paper.

In addition, Zero2IPO finds that internet, IT, and telecommunication service industries attract the greatest amount of funds from VC firms. Investment is also more concentrated in Beijing, Shanghai, and Shenzhen.

2.2. The IPO Market in China

In developed capital markets, on average IPOs are underpriced by around 15%.[2] In emerging markets such as Malaysia, the ratio is over 80%, whereas in China, it sometimes reaches 200%, according to the China Center for Economic Research (CCER) database. IPOs in China are constantly sought after, with a high excess return. This is caused by the imbalance between the supply and demand for new shares, the regulated pricing mechanism, and government regulations.

Before 2005, China adopted a pricing system where firms could only select price to earnings (P/E) ratios of 20 or 30 on issuing. With such high pricing levels, firms were eager to go public. The quality of listed corporations was difficult to evaluate because prices have lost their signaling function. New regulations introduced at the end of 2004 allowed prices to be set as a range during the initial enquiry, and to be decided only after the book-building mechanism.[3] However, in 2012, another reform requires further information disclosure if the P/E ratio rose above 125% of the industry average.[4] This resulted in a partial return to government price control, as many corporations avoided crossing the threshold. The regulation was abandoned one year later. Meanwhile, individual investors were also allowed to participate in initial enquiry procedures, which was previously limited to institutional investors only.[5] Diversified regulations were introduced in 2013.[6] Among the new regulations, several details are worth mentioning. First, underwriter autonomy in rationing, and the communication of information between the issuer and the underwriters, were reinforced. Second, pre-announcements had to be posted right after the declaration, and the term to validly issue an approval was extended from 6 to 12 months, thereby increasing documentation requirements

[2] See China Venture Capital Annual Reports.

[3] "Notices on enquiry implementation of initial public offering" launched by SEC, 2 Dec 2004.

[4] Instruction launched by SEC, 28th April 2012.

[5] <Management of securities issuance and underwriting>, 2012. "Book-building participants include institutional investors with high ability of valuation and long term invest tendency, individual investors with rich experience"

[6] <Management of securities issuance and underwriting>, 2013.

and the time management skills of underwriters. Finally, second offerings were permitted to mitigate the "super raising IPO" phenomenon.

New regulations that were implemented in 2014 also aimed to promote pricing accuracy and efficiency,[7] such as those requiring 90% of total shares to be issued online if the online subscription exceeded total shares by 150 times.

The current IPO pricing procedure in China consists of three steps. First, the issuer and the sponsor institution make an initial inquiry among selected book-building participants to set the price interval. Second, all book-building participants join an accumulated bidding inquiry. The offer price is then settled, and shares are offered to subscribed book-building participants. Finally, the remaining shares are offered online to public investors at the same price.

2.3. Investor Composition in China

As an emerging market, China's secondary stock market is different from those in developed economies in many ways. One of the most visible differences is in investor composition. The Shanghai Stock Exchange classifies investors into three categories: individual investors, institutional investors, and general legal persons. General legal persons refer to the majority of shareholders who are rarely involved in secondary market transactions, except for strategic investment. The category accounts for more than 60% of total market value, but only 2% of annual transaction volume. In contrast, individual and institutional investors constitute about 21% and 16% of market value, while contributing 80% and 15% of annual transaction volume, respectively. These figures from the Shanghai Stock Exchange clearly show that individual investors are the main active participants in the Chinese secondary stock market. In the Shenzhen Stock Exchange, individual investors

[7] "Amendment on < Management of securities issuance and underwriting >", 21 March 2014.

own 43% of total market value and account for 86% of annual transaction volume, with 18% and 10% for institutional investors, correspondingly. In 2011, 2012, 2013, and 2014, the total stock value held by individual investors accounted for 73.30%, 72.98%, 77.02%, and 78.41% of the total circulation value respectively, reaching a high of 85.33% in the third quarter of 2015.[8]

In contrast, institutional investors in developed markets account for nearly 80% of the circulation value and 70% of the annual transaction volume. In 1950, individual investors accounted for more than 90% of the circulation value of the American stock market. Direct individual investor participation decreased as the market developed. Individual American investors became more willing to invest their wealth in funds managed by institutional investors because of complicated transaction mechanisms and tax preferences, among other reasons. For example, most American citizens have 401(k) pension accounts managed by pension funds. These funds are the main source of capital for the American stock market.

Compared with institutional investors, individual investors tend to behave more irrationally. A study conducted by the Shenzhen Stock Exchange shows that capital turnover among individual investors, measured as the transaction to capital ratio, was four times that of institutional investors. The average stock holding period of individual investors is only one-fifth of that of institutional investors. Individual investors are the main holders of stocks with low price, poor operational performance, and high PE ratios. These characteristics show that individual investors are prone to speculative behavior. Moreover, most of the participants that actively bid on the first IPO trading day are individual

[8] The data are obtained from the annual reports published by the Shanghai Stock Exchange and the Shenzhen Stock Exchange.

investors. They account for nearly 90% of the total trading volume on the first trading day, and 60% of them face a loss subsequently.

The regulations on IPO and individual investor participation might be the leading factors of the "double high" phenomenon, or the high IPO PE ratios and premiums of IPOs in mainland China's stock markets. IPO PE ratios in mainland markets can exceed 30, while they are around 20 in Hong Kong and Taiwan markets. European markets have lower ratios, at around 13. Even the technology, media, and telecommunications industry in America only reaches a PE ratio of 25 during IPO.[9] Similarly, China's first day premium after IPO also exceeds most of the other markets stated above.

3. Data and Variables

3.1 Data Description

The data are obtained from CV Source[10] and Wind databases from January 1st, 2005 to December 31st, 2014, covering firms listed on the A-share markets. A total of 1,265 samples were collected, including 636 VC-backed firms and 629 non-VC-backed firms. Firms with missing values are disregarded. We order the samples by year and find that VC activity is growing in the IPO market, as clearly indicated by the increase in the proportion of VC-backed IPOs over time in Table 1.

[9] Dealogic Quarterly Reviews-Third Quarter 2015.
[10] http://www.cvsource.com.cn/

Table 1: The Percentage of VC-Backed IPO in Each Year

Year	VC-Backed IPOs	% of Total	Non-VC-Backed IPOs	% of Total	Total
2005	5	0.357	9	0.643	14
2006	15	0.231	50	0.769	65
2007	41	0.333	82	0.667	123
2008	27	0.355	49	0.645	76
2009	52	0.591	36	0.409	88
2010	169	0.491	175	0.509	344
2011	152	0.547	126	0.453	278
2012	94	0.618	58	0.382	152
2013	0	NA	0	NA	0
2014	81	0.648	44	0.352	125
2005-2014	636	0.503	629	0.497	1265

The stock market in China is subject to significant government intervention. Up until the end of 2014, IPO activities have been suspended eight times for periods ranging from 3 to 12 months. These suspensions functioned as an instrument of regulation and control, particularly at times when regulators were attempting to stabilize the market or launch market reforms (Piotroski and Zhang, 2014). Four suspensions occurred in our sample period: from August 2004 to January 2005, from May 2005 to June 2006, from December 2008 to June 2009, and from October 2012 to January 2014. Reports published by Securities Times have shown that IPO suspensions do not significantly influence the market.[11] As such, suspension periods are omitted from our analysis. The ratio of VC-backed IPOs by month is shown in Figure 1.

[11] See http://www.stcn.com/2015/1106/12470715.shtml.

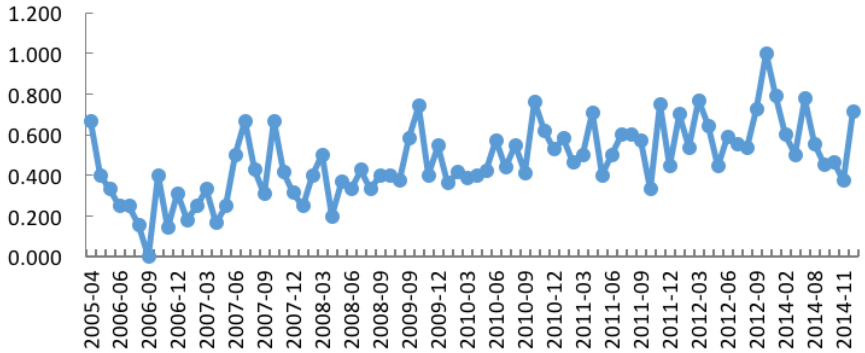


Figure 1: The Percentage of IPO with VC Backing

In general, the monthly proportion of VC-backed IPOs has shown an upward trend during the last 10 years, albeit with significant fluctuations. There are three hypotheses explaining this phenomenon. First, VC firms have the professional skills to identify potential start-ups that may conduct an IPO. Second, VC firms can bring management and development strategies to start-ups, offering financial support to help them capture a greater market share in the product market. Lastly, VC firms have increased in number and professional competency over our sample period, resulting in more VC activity in IPOs.

The explained variables employed in this study are the measurements for underpricing in IPO and its volatility. Different measures have been proposed in the literature for the underpricing of IPO. For example, Ruud (1993) takes the percentage difference between the IPO offering price and the closing price on the first trading day as a proxy for underpricing. Lowry et al. (2010) employ monthly initial return, arguing that it is a more accurate reflection of actual market value. Figure 2 displays initial returns over time, from the first day to the end of the first year.

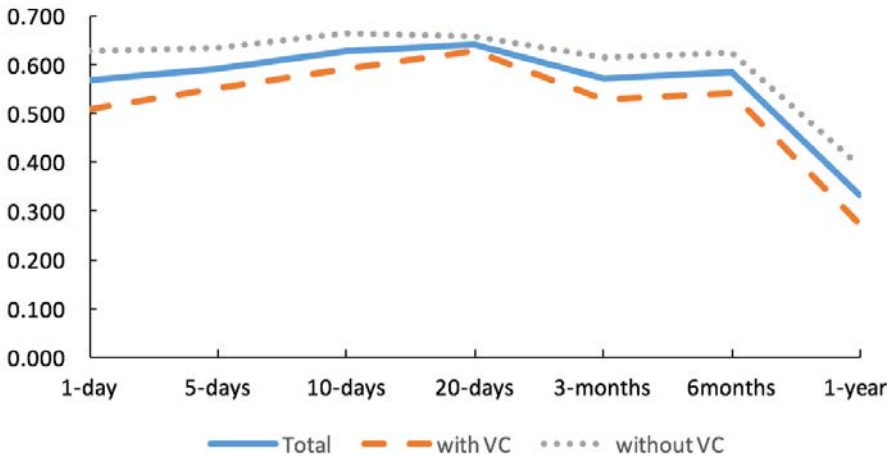


Figure 2: Initial Returns

The initial return curve of non-VC-backed firms lies above that of VC-backed firms. Both increase slightly before the 21st trading day and decrease thereafter. In particular, the 1-day and the 20-day returns are 51% and 60% for VC-backed IPOs, and are 62% and 63% for non-VC-backed IPOs, respectively. These figures eventually drop to 32% and 40% at the end of the first year. This is caused by the IPO lock-up effect. Regulations state that the lock-up periods for pre-IPO shareholders and controlling shareholders are at one year and three years, respectively. Overall, we find that underpricing is similar across various windows. In addition, the initial return gap between VC-backed and non-VC-backed firms is relatively persistent.

We use the initial return on the 21st trading day to measure underpricing. The averages of the initial returns and their standard deviations in each month are calculated for firms that went public in that month. Months with less than two firms conducting IPOs are omitted. The summary statistics in Table 2 and Figure 3 depict these monthly averages and cross-sectional standard deviations over time.

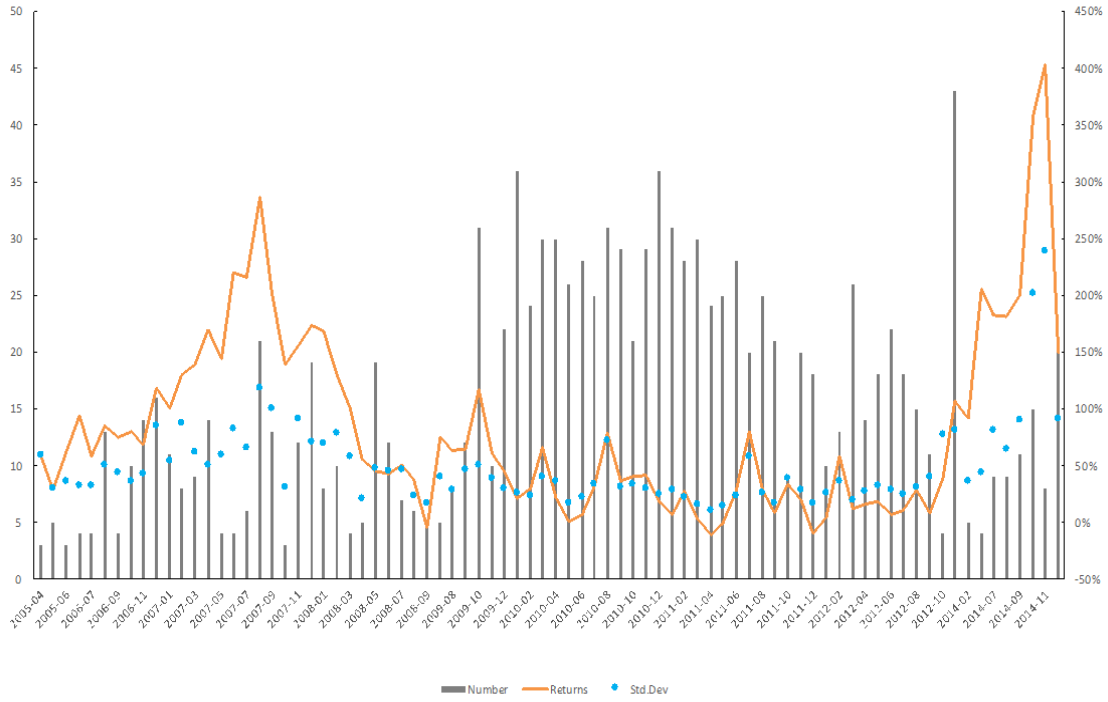


Figure 3: Monthly Average and Standard Deviation of Initial Returns

Figure 3 shows that the initial return increases with the standard deviation, while the monthly number of IPOs decreases with standard deviation. However, the correlation between the number of IPOs and initial return is not obvious – this relationship is analyzed in greater detail in the following sections.

Table 2: Autocorrelations of the Monthly Average of Initial Returns and Its Standard Deviation

						Autocorrelations: Lags				
	N	Mean	Median	Std. Dev.	Corr.	1	2	3	4	5
Average IPO initial returns	80	0.815	0.579	0.812	0.883	0.821	0.720	0.686	0.624	0.519
Cross-section standard deviation of IPO IRs	80	0.488	0.374	0.361		0.652	0.433	0.467	0.367	0.280

The autocorrelations of the independent variables are calculated, omitting months with fewer than three IPOs. Table 2 contains the descriptive statistics for Figure 3. The average and the standard deviation of IPO initial returns are strongly correlated, with a value of 0.883. In addition, the initial return and the standard deviation are both highly autocorrelated for up to five lags, though this falls smoothly with increasing lags.

3.2. Descriptive Evidence

The sample includes firms listed on the A-share markets for the 10-year period spanning from January 1st, 2005 to December 31st, 2014. For each firm, we collect closing price, as well as the price and the number of shares offered at IPO. Total funds raised are calculated by multiplying the offering price by the number of shares offered. Four dummy variables are also used: a VC dummy, an underwriter rank dummy, a technology dummy, and a market dummy. Measures of firm- , offer- and market-specific characteristics are also included, such as the firm's age, debt-to-asset ratio, percentage of tradable shares and ownership concentration in the year of IPO, the listed market, and the IPO volume in the listing month.

Offer- and market-specific characteristics include the following variables:

a) "Log(Fund Raised)" is the logarithm of the total funds raised through an IPO. More information tends to be available in large offerings, suggesting that these stocks are easier for underwriters to value. This reduces information asymmetry between issuers and investors in the primary market.

b) "Rank" captures underwriter ability in IPO pricing. We rank underwriters according to their IPO business volumes in each year. The dummy variable equals 1 if the underwriter is among the top 10 in that year, and 0 otherwise. In Lowry et al. (2010), Lee et al. (2004), and Loughran and Ritter (2002), the underwriters are ranked from 0 to 9, with the same rankings employed for all

the years covered. We believe with certainty that valuation ability will change over time, albeit not to a large extent. As such, we update the rank list every year in this study. The result is relatively practical, with some securities companies (e.g., China International Capital Corporation and CITIC Securities) consistently being among the top 10, while others being included or excluded from the lists over the sample period. Highly ranked underwriters can estimate market demand and firm value accurately, suggesting a negative relationship between underwriter rank and underpricing.

c) "Market" is assigned the value 1 for firms listed on the Shanghai Main Board, and 0 for firms listed on the Shenzhen SME and the GEM Boards. The market assigns high PE ratios to firms listed on the GEM Board, which opened in 2009. High-tech firms and young firms tend to go public on the SME and the GEM Boards, suggesting a greater difficulty in valuing these firms. d) "IPO_Market" refers to the number of firms that were listed in that month.

Firm-specific characteristics include the following:

a) "Leverage" is equal to the debt-to-assets ratio in the year of IPO. A firm with high leverage may appear risky to equity investors.

b) "Log(FirmAge+1)" is calculated as the logarithm of one plus the number of years since the firm was founded, measured at the time of the IPO (Lowry et al., 2010).

c) "Tech" takes a value of 1 for firms in the high-technology industry, and 0 for other firms. The high-tech industry includes the following five categories, as defined by the China Securities Regulatory Commission: telecommunications, radio and television and satellite transmission services; radio, television, film, and film and television sound recording production industry; internet and related services; manufacturing of computers,

communications and other electronic equipment; and software and information technology services. Firms in the high-technology industry are harder to value.

d) "VC" comes from the CV Source and is equal to 1 if the firm has received funds from VC firms prior to listing, as defined by the CV Source, or 0 otherwise. The intervention of VC firms may function as a positive signal on the prospects and the value of the firm based on prior professional selection, support, and supervision. On the other hand, the desire to build reputation to attract additional funds in the future may negatively affect a VC firm's function of being an authentication agent.

A summary of variable definitions is given in Table 3.

Table 3: Definition of Variables

Variables	Definitions
IR	The percentage difference between the offer price and the aftermarket price on the 21st trading day
Log(Fund Raised)	The logarithm of total proceeds raised, calculated by multiplying the number of shares offered in the IPO by the offering price
Leverage	The debt-to-asset ratio in the year of IPO
Log(FirmAge+1)	The logarithm of one plus the number of years since the firm was founded, measured at the time of IPO
Percentage of Tradable Shares (PTS)	Tradable shares divided by total shares in the year of IPO
Concentration	Ownership concentration in the year of IPO
VC	1 if the firm received financing from venture capital, and 0 otherwise
Tech	1 for firms in the high-tech industry (such as internet, computer equipment, communications), and 0 otherwise.
Rank	1 for highly ranked underwriters (underwriters among the top 10 in IPO business volume in that year), and 0 otherwise
Market	1 if the firm is listed on Shanghai Main Board, and 0 otherwise
IPO_Market	The number of firms listed that month

Table 4: Correlations between Variables

	Average IPO Initial Returns	Std. Dev. of Initial Returns
Log(Shares)	0.270	0.139
Log(Fund Raised)	-0.259	-0.312
Log(FirmAge+1)	0.102	0.061
Leverage	0.443	0.321
Tech	-0.079	-0.090
VC	-0.159	-0.060
Rank	-0.030	-0.105
Market	0.527	0.469
PTS	0.268	0.237
Concentration	-0.022	-0.019
IPO_Market	-0.328	-0.205

In Table 4, we use monthly data to obtain the correlations between the measures and various variables to get an approximate view. As shown in Table 4, variables such as the number of firms listed that month (*IPO_Market)* and firm debt to asset ratios in that year (*Leverage)* are more correlated with average IPO initial returns and the standard deviation of initial returns. For other variables, such as VC funding (*VC*) and firms in the technology industry (*Tech*), the relations are low. A larger amount of funds raised as well as a lower leverage and tradable shares ratio are associated with a lower IPO initial return and variation.

4. Estimation Results

The results in this section show the effects of firm- and offer-specific factors on monthly initial return and variance.

4.1. Statistical Interpretation

Table 5 shows that no difference is observed between the initial returns of VC-backed and non-VC-backed firms. For other characteristics, our data show that when compared to non-VC-backed firms, VC-backed firms are younger and have lower debt ratios and smaller ownership concentrations at the time of IPO. These firms can be listed quickly (as shown by the firms' age) and tend to raise large funds during IPOs.

Significantly and quite differently, these findings show that VC firms prefer to invest in the high-technology industry and employ highly ranked underwriters, supporting Gompers (1996)'s grandstanding effect. This suggests that VC firms tend to bring young firms to IPO at the cost of high underpricing, in order to build reputations that can attract additional funds in the future.

Table 5: Difference Tests on VC-Backed and Non-VC-Backed Firms

	VC Backed		Non-VC Backed		T-test
	Mean	Std. Dev	Mean	Std. Dev	(P value)
IR	0.645	0.998	0.660	0.861	0.742
Log(Fund Raised)	4.760	0.383	4.696	0.391	0.002***
Log(FirmAge+1)	1.210	0.111	1.223	0.113	0.038**
Tech	0.250	0.433	0.149	0.357	0.000***
Rank	0.508	0.500	0.404	0.491	0.000***
Market	0.145	0.352	0.146	0.353	0.868
Leverage	25.472	18.921	27.655	17.902	0.014**
PTS	20.613	5.267	20.671	5.214	0.698
Concentration	72.438	8.446	73.808	9.435	0.007***
IPO_Market	22.92	9.548	20.669	9.447	0.000***
Observations	636		629		

Note: *** p<0.01, ** p<0.05, * p<0.1

Table 6 shows that the firms listed on the Shanghai Main Board diverge from those on the Shenzhen Small and Medium Enterprise Board (SME) and the Growth Enterprise Market Board (GEM) in terms of firm- and offer-specific characteristics. Main board firms have higher average initial returns, raise more funds, and are in the charge of highly ranked underwriters. Firms on the SME or the GEM Boards are more likely to be backed by VC firms and to be associated with the high-technology industry.

Table 6: Difference Tests on the SME, GEM, and Shanghai Main Boards

	SME and GEM		Shanghai Main		T-test
	Mean	Std. Dev	Mean	Std. Dev	(P value)
IR	0.625	0.860	0.806	1.263	0.000***
Log(Fund Raised)	4.646	0.287	5.212	0.529	0.000***
Log(FirmAge+1)	1.221	0.106	1.185	0.140	0.000***
VC	0.503	0.500	0.497	0.500	0.000***
Tech	0.227	0.419	0.044	0.204	0.000***
Rank	0.422	0.494	0.661	0.473	0.000***
Leverage	23.705	15.956	43.089	22.842	0.010**
PTS	20.589	3.468	21.006	10.842	0.559
Concentration	72.556	8.407	76.356	11.196	0.000***
IPO_Market	22.440	9.428	18.049	9.644	0.000***
Observations	1080		185		

Note: *** p<0.01, ** p<0.05, * p<0.1

The sample is also sorted by the underwriter's rank. As shown in Table 7, the differences between initial returns are insignificant. Highly ranked underwriters engage in large-scale IPOs, as measured by the volume of funds raised. IPOs tend to take place on the Shanghai Main Board if highly ranked

underwriters are employed. Firm-specific characteristics are also significantly different. The firms with highly ranked underwriters bear high leverage and have high ownership concentration.

Table 7: Difference Tests on Highly Ranked and Not Highly Ranked Underwriters

	Highly Ranked		Not Highly Ranked		T-test
	Mean	Std. Dev	Mean	Std. Dev	(P value)
IR	0.578	0.841	0.715	0.999	0.472
Log(Fund Raised)	4.828	0.451	4.645	0.303	0.000***
Log(FirmAge+1)	1.212	0.119	1.220	0.106	0.119
VC	0.560	0.496	0.455	0.498	0.000***
Tech	0.203	0.402	0.198	0.398	0.886
Market	0.210	0.406	0.092	0.288	0.000***
Leverage	28.326	20.599	25.075	16.265	0.000***
PTS	20.703	6.634	20.590	3.682	0.056*
Concentration	73.872	9.282	72.488	8.647	0.005***
IPO_Market	20.780	9.664	22.622	9.437	0.000***
Observations	597		688		

Note: *** p<0.01, ** p<0.05, * p<0.1

Our sample consists of 253 high-technology firms. From Table 8, the initial returns of firms in the high-technology industry are significantly higher than those of non-high-technology firms. Compared to non-high-technology firms, high-technology firms are on average younger, with significantly lower leverage and smaller percentages of tradable shares. Most of these high-technology firms are listed on the SME or the GEM Boards. In contrast to VC-backed firms, high-technology firms do not employ highly ranked underwriters.

Table 8: Difference Tests on High Tech and Non-High Tech Firms

	High Tech		Non-High Tech		T-test
	Mean	Std. Dev	Mean	Std. Dev	(P value)
IR	0.678	0.895	0.646	0.941	0.000***
Log(Shares)	3.292	0.228	3.525	0.454	0.000***
Log(Fund Raised)	4.622	0.287	4.755	0.406	0.425
Log(FirmAge+1)	1.205	0.102	1.219	0.115	0.000***
VC	0.628	0.483	0.471	0.499	0.000***
Rank	0.462	0.499	0.455	0.498	0.663
Market	0.032	0.175	0.174	0.379	0.000***
Leverage	18.278	12.275	28.628	19.146	0.000***
PTS	20.477	2.841	20.683	5.684	0.001***
Concentration	72.477	7.155	73.280	9.371	0.229
IPO_Market	22.538	9.256	21.593	9.671	0.000***
Observations	253		1012		

Note: *** p<0.01, ** p<0.05, * p<0.1

4.2. The Model

We estimate the following model:

$$\begin{aligned} IR_i = {} & b_0 + b_1 Log(Fund\ Raised)_i + b_2 Rank_i + b_3 Market_i + b_4 IPO\_Market_i \\ & + b_5 Leverage_i + b_6 VC_i + b_7 Tech_i + b_8 Log(FirmAge+1)_i + b_9 Concentration_i , \\ & + b_{10} PTS_i + e_i \end{aligned} \quad (1)$$

$$\begin{aligned} Log(s^2(e_i)) = {} & a_0 + a_1 Log(Fund\ Raised)_i + a_2 Rank_i + a_3 Market_i + a_4 IPO\_Market_i \\ & + a_5 Leverage_i + a_6 VC_i + a_7 Tech_i + a_8 Log(FirmAge+1)_i \\ & + a_9 Concentration_i + a_{10} PTS_i \end{aligned} \quad ,(2)$$

The variance of the error term in the mean regression model is assumed to be a function of the same firm- and offer-specific characteristics in the initial return regression model. The maximum likelihood estimator is similar to the least squares estimator for the initial return equation, and uses the standard deviations as weights. The advantage of this approach is that it enables us to estimate the influence of each characteristic on both levels, namely initial returns and the uncertainty of firm-level initial returns (Lowry et al., 2010).

As shown in Section 2, notable autocorrelations between the initial return and its variance are found. We treat the data as time series data (Lowry et al., 2010). Individual observations are considered a realization of a time series process, and we order the firms by the dates of their offers. When multiple IPOs are offered on a single day, we randomly order the firms in question.

$$\begin{aligned} IR_i = {} & b_0 + b_1 Log(Fund\ Raised)_i + b_2 Rank_i + b_3 Market_i + b_4 IPO\_Market_i \\ & + b_5 Leverage_i + b_6 VC_i + b_7 Tech_i + b_8 Log(FirmAge+1)_i + b_9 Concentration_i \\ & + b_{10} PTS_i + qIR_{i-1} + (1+jL)e_i \end{aligned}, \quad (3)$$

$$\begin{aligned} Log(s^2(e_i)) = {} & a_0 + a_1 Log(Fund\ Raised)_i + a_2 Rank_i + a_3 Market_i + a_4 IPO\_Market_i \\ & + a_5 Leverage_i + a_6 VC_i + a_7 Tech_i + a_8 Log(FirmAge+1)_i \\ & + a_9 Concentration_i + a_{10} PTS_i \end{aligned}, \quad (4)$$

As a benchmark, we run an OLS regression and determine that the residuals are highly clustered. OLS is not able to capture the characteristics of the data as shown in Table 9 and Figure 4.

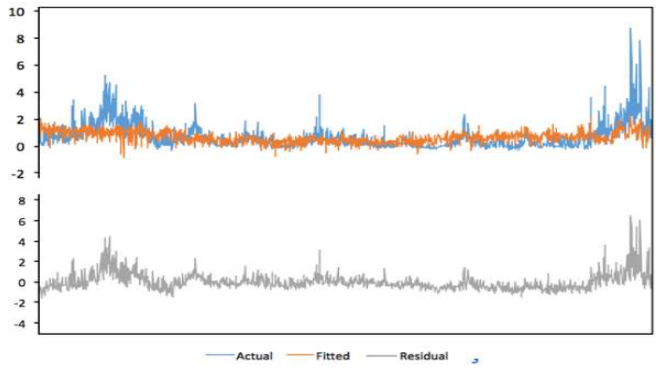
Table 9: Estimation Results

	OLS	MLE	ARMA(1,1)
Intercept	5.237	2.718	0.448
	(8.440)	(6.253)	(2.830)
Leverage	0.009***	0.007***	0.001**
	(5.170)	(5.922)	(2.230)
Log(FirmAge +1)	-0.180	-0.059	0.057
	(-0.940)	(-0.364)	(0.810)
IPO_Market	-0.011***	-0.011***	0.000
	(-4.090)	(-4.635)	(0.033)
Tech	0.063	0.096**	0.021
	(1.030)	(2.183)	(1.163)
Rank	-0.079*	-0.032	-0.055***
	(-1.720)	(-0.872)	(-3.465)
VC	0.100**	0.057	0.032**
	(2.086)	(1.573)	(2.382)
Market	0.556***	0.215***	0.021
	(6.638)	(2.952)	(0.753)
Concentration	0.003	0.002	-0.002*
	(0.997)	(0.813)	(-1.927)
Log(Fund Raised)	-1.030***	-0.517***	-0.088***
	(-13.625)	(-7.832)	(-3.829)
PTS	0.010**	0.014***	0.001
	(2.291)	(3.344)	(0.480)
AR(1)			0.959
			(126.248)
MA(1)			-0.826
			(-37.056)
Variance intercept		6.468	4.704
		(8.122)	(5.921)
Leverage		0.016***	0.020***
		(6.682)	(8.589)
Log(FirmAge +1)		-1.044**	-0.084
		(-2.456)	(-0.200)

IPO_Market		-0.040***	-0.023***
		(-8.334)	(-5.276)
Tech		-0.082	0.097
		(-0.771)	(0.915)
Rank		-0.064	-0.130
		(-0.693)	(-1.450)
VC		0.466***	0.348***
		(5.502)	(3.956)
Market		0.513***	0.987***
		(3.451)	(6.401)
Concentration		0.006	-0.006
		(1.446)	(-1.323)
Log(Fund Raised)		-1.403***	-1.262***
		(-11.256)	(-11.787)
PTS		0.022***	0.007
		(2.771)	(1.153)
Log Likelihood	-1629.109	-1362.266	-969.236
AIC	3114.012	2768.531	1986.471
Box-Ljung	0.000	0.000	0.003
Sample Size	1265	1265	1265

*Figures in parentheses are t-statistics.

The fitted values and residuals of OLS and ARMA(1,1) models are compared in Figure 4. The ARMA(1,1) model captures the volatility of the data well, with the autocorrelation of the error term identified.



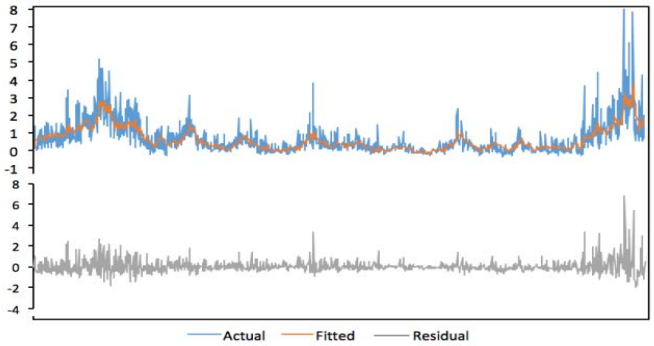


Figure 4: Comparison of OLS and ARMA(1,1) Results

The magnitude of the AR and the MA terms indicates that the residual autocorrelations are persistent.

For firm-specific characteristics, the age of the firm and whether the firm is involved in the high-technology industry do not affect IPO underpricing or the volatility. The estimation results above show that VC-backed firms are younger and more likely to be involved in the high-technology industry. While being "younger" or "high-tech" does not seem to cause greater uncertainty, this information does not seem to be valued by investors either. The reason may lie in the fact that the majority of investors in the Chinese stock markets are individual investors, particularly in the secondary market. This will influence the estimation of value in the primary market.

VC backing positively affects underpricing and volatility. On the one hand, VC backing sends a positive signal on the prospects and the value of the firm, on the basis of professional selection, support, and supervision. This reduces information asymmetry, leading to lower underpricing. Additionally, VC firms tend to hire highly ranked IPO underwriters, which reduces the possibility of underpricing. On the other hand, VC firms may desire to build up their reputation to attract additional funds in the future, at the cost of high underpricing. In our sample, the rankings of underwriters for VC-backed firms

are higher on average than those for non-VC-backed firms. The regression result suggests that a highly ranked underwriter can reduce underpricing. The positive effect of VC may be purely an intentional phenomenon on the part of VC firms to build up their reputation. While the "authentication agents effect" seems to be overwhelmed by the reputation-building effort, the leverage and the total funds raised parameters coincide with initial expectations, implying that increased uncertainty can cause large underpricing and volatility in IPOs. Figure 2 shows that the initial returns of VC-backed firms at various points in time are all lower than those of non-VC-backed firms. The correlations between each set of variables are calculated in Table 10.

Table 10: Correlations between Variables

	IR	Leverage	Log(Firm Age+1)	IPO_ Market	Tech	Rank	VC	Market	Concentration	Log (Fund Raised)
Leverage	0.193									
Log(FirmAge+1)	0.037	0.073								
IPO_Market	-0.262	-0.285	-0.121							
Tech	0.014	-0.224	-0.050	0.039						
Rank	-0.073	0.088	-0.035	-0.096	0.006					
VC	-0.008	-0.059	-0.057	0.118	0.126	0.104				
Market	0.066	0.371	-0.110	-0.164	-0.161	0.167	-0.002			
Concentration	-0.025	0.044	-0.099	-0.03	-0.036	0.077	-0.076	0.153		
Log(Fund Raised)	-0.314	0.187	-0.138	0.155	-0.136	0.234	0.083	0.515	0.180	
PTS	0.120	0.071	0.017	-0.148	-0.016	0.011	-0.006	0.023	-0.154	-0.070

Table 11 lists the regression results of the parameters of VC by adding extra variables to a basic model (Column A). The "All" column shows the outcome of the regression that contains all variables. The regression in Column A only

contains the VC dummy. Column B adds the technology dummy, and Column C adds the underwriter rank dummy to the regression in Column B. Additional variables added in Columns E and F are IPO_Market and Log (Fund Raised), respectively.

With more variables (which are shown to be significantly negative in Table 9, and the correlations shown to be significant in Table 10), the VC parameter becomes significantly positive. It identifies the fact that the pattern shown in Figure 2 is the gross influence of VC, as expressed through the relationship between the underwriter and the volume of funds raised. When volatility is used to indicate the degree of information asymmetry, an increase in influence and the significance level is also observed.

Table 11: Coefficients of the VC Dummy in Different Regressions

	All	A	B	C	E	F
Mean Equation						
VC	0.032	0.013	0.011	0.012	0.025	0.033
	(2.382)	(0.801)	(0.663)	(0.766)	(1.724)	(2.299)
Variance Equation						
VC	0.348	0.350	0.361	0.371	0.444	0.598
	(3.956)	(4.312)	(4.403)	(4.522)	(5.410)	(7.136)

*Figures in parentheses are t-statistics.

We group the sample by the VC and the market dummies, and list the results in Table 12.

Table 12: Categorical Regression Results

	ALL	Non-VC Backed	VC Backed	SME or GEM	SH Main
Intercept	0.448	0.931	0.466	0.358	0.572
	(2.830)	(3.575)	(2.404)	(2.424)	(2.080)
Leverage	0.001**	0.000	0.001	0.001	-0.004***
	(2.230)	(0.530)	(1.070)	(1.236)	(-3.194)
Log(FirmAge +1)	0.057	0.065	0.071	0.075	0.124
	(0.810)	(0.532)	(0.719)	(1.053)	(0.756)
IPO_Market	0.000	0.000	0.000	0.000	-0.008***
	(0.033)	(-0.342)	(-0.549)	(-0.909)	(-4.890)
Tech	0.021	-0.028	0.045*	0.014	-0.056
	(1.163)	(-0.754)	(1.870)	(0.737)	(-0.832)
Rank	-0.055***	-0.056**	-0.061***	-0.060***	-0.126***
	(-3.465)	(-2.007)	(-3.311)	(-3.959)	(-3.871)
VC	0.032**			0.026*	0.094**
	(2.382)			(1.885)	(2.127)
Market	0.021	0.085	0.060		
	(0.753)	(1.540)	(1.374)		
Concentration	-0.002*	-0.001	-0.002**	-0.001	0.002
	(-1.927)	(-0.566)	(-2.408)	(-1.585)	(1.111)
Log(Fund Raised)	-0.088***	-0.199***	-0.074***	-0.075***	-0.128***
	(-3.829)	(-5.012)	(-2.668)	(-3.580)	(-2.494)
PTS	0.001	0.002	-0.001	0.001	0.002
	(0.480)	(0.793)	(-0.956)	(0.676)	(0.852)
AR(1)	0.959	0.899	0.973	0.971	0.964
	(126.248)	(49.063)	(148.824)	(152.437)	(54.366)
MA(1)	-0.826	-0.691	-0.841	-0.817	-0.779
	(-37.056)	(-17.598)	(-41.342)	(-42.007)	(-17.865)
Variance Intercept	4.704	8.028	-0.061	2.913	-0.051
	(5.921)	(6.845)	(-0.073)	(3.841)	(-0.068)
Leverage	0.020***	0.007**	0.009***	0.025***	-0.001
	(8.589)	(2.041)	(3.366)	(10.197)	(-0.464)
Log(FirmAge +1)	-0.084	-0.523	0.015	-1.325***	0.073
	(-0.200)	(-0.853)	(0.040)	(-3.623)	(0.211)
IPO_Market	-0.023***	-0.021***	0.006	-0.019***	0.003
	(-5.276)	(-3.247)	(1.079)	(-4.888)	(0.695)
Tech	0.097	-0.176	-0.439***	0.150	-0.152
	(0.915)	(-0.992)	(-4.246)	(1.433)	(-1.419)
Rank	-0.130	0.050	0.151*	0.057	-0.250***
	(-1.450)	(0.374)	(1.758)	(0.642)	(-2.882)

VC	0.348***			0.102	0.128
	(3.956)			(1.184)	(1.524)
Market	0.987***	0.773***	0.035		
	(6.401)	(3.090)	(0.218)		
Concentration	-0.006	0.000	0.001	0.004	-0.001
	(-1.323)	(0.057)	(0.145)	(0.933)	(-0.297)
Log(Fund Raised)	-1.262***	-1.878***	-0.299**	-0.753***	-0.060
	(-11.787)	(-10.557)	(-2.325)	(-7.399)	(-0.512)
PTS	0.007	0.006	-0.004	0.010	-0.008
	(1.153)	(0.653)	(-0.604)	(1.557)	(-1.201)
Log Likelihood	-969.236	-449.211	-1063.540	-893.123	-1449.053
AIC	1986.471	942.420	2171.081	1830.246	2942.106
Sample Size	1265	629	636	1080	185

*Figures in parentheses are t-statistics.

No obvious discrepancy is observed between the VC-backed and the non-VC-backed groups when underpricing is employed as the index. In the variance equation, the results differ. The number of firms listed in that month and listed on the SME or GEM Boards negatively influence the volatility in the non-VC-backed group, but do not significantly influence volatility in the VC-backed group. This finding implies that the initial returns of the non-VC-backed firms are highly sensitive to market-specific characteristics, while the underpricing levels are more stable for VC-backed firms.

VC support may be treated as a reliable signal to investors under varying situations. For firm-specific characteristics such as leverage, whether a firm is involved in the high-technology industry will significantly affect the volatility of VC-backed firms, but insignificantly for non-VC-backed firms. With VC backing, corporate fundamentals play a more important role in valuation. These findings imply that although VC firms in China value reputation greatly, they also play the role of authentication agents. In the preceeding analysis in Section 3, this function is offset by the grandstanding effect, which has a positive influence on underpricing.

The regression results of the initial return equations do not show a distinct difference between firms listed on the Shanghai Main Board and those listed on the SME or the GEM Boards. When volatility is employed as the index, the SME or GEM group responds actively in general. Young firms, which are perceived by investors as riskier, have high return volatility on the SME or the GEM Boards. The number of firms listed in that month, which is a market-specific characteristic, negatively influences the volatility of initial returns. Additionally, the greater the amount of funds raised, the smaller the volatility of the returns on the SME or the GEM Boards. These results confirm the hypothesis that increased uncertainty can cause large volatility in post-IPO returns. Based on this information, the SME and the GEM Boards, which attract young high-technology firms and are associated with greater underpricing, seem to be slightly more efficient than the Shanghai Main Board.

5. Conclusions

Taking the initial return and the volatility of public firms in China as indices, we explore the effect of VC involvement on the difficulty of valuation and compare the market- and firm-specific characteristics of VC-backed and non-VC-backed firms. The findings show that VC firms in China can generally act as effective authentication agents and reduce the complexity of valuation. We show that this effect is smaller than the effect brought by their eagerness to build their reputations. Other variables, such as the ability of underwriters and firm attributions, signify that increased uncertainty can cause large underpricing and volatility in IPO.

The gross influence of VC on the uncertainty of valuation, represented by underpricing, is negative. First, underpricing is a cost to VC firms. High underpricing implies significant gains that are forgone by the VC firm. Setting

a low offering price to attract investors or bringing young firms to IPOs helps VC firms strengthen their reputation to attract additional funds. Second, VC backing may suggest a positive signal on the prospect and the value of the firm based on prior professional selection, support, and supervision. Additionally, VC firms can employ reputable underwriters through their advantages in networking. This can reduce uncertainty. These findings coincide with those of Chahine et al. (2007) for VC firms in France, and are opposite to the case of VC firms in England.

A more detailed study shows that for non-VC-backed firms, initial returns are more sensitive to market-specific characteristics, and corporate fundamentals play less important roles in valuation when compared to VC-backed firms. This indicates that although the VC firms in China value reputation greatly, they still act as authentication agents.

In particular, we show that VC-backed firms in China are young, bear low debt ratios, and are inclined to be in a high-technology industry at the time of IPO. In addition, these firms tend to be listed on the SME or the GEM Boards instead of the Shanghai Main Board, the latter of which includes many state-owned enterprises. This finding is consistent with the government's purpose of establishing the SME and the GEM Boards.

The information of firms listed on the SME or the GEM Boards generally receives numerous active responses. The SME and the GEM Boards attract high-technology firms and young firms, both of which are associated with significant underpricing. These markets seem to act slightly more efficiently than the Shanghai Main Board.

The influence of firm characteristics, such as leverage and total funds raised, are in line with our expectations. Increased uncertainty can cause large underpricing and volatility in IPO. A firm's age and level of technology in the industry will not affect amount of underpricing level during IPO or the

volatility. This finding shows that information is not rationally processed in the Chinese market. These observations may be reflective of the characteristics of investors that constitute the Chinese market. Compared with underpricing, which is widely used as a response to uncertainty in valuation, volatility seems to function as a better index in representing the complexity of valuation.

Overall, our study addresses relevant implications for investors, managers of issuing firms, and governments. Investors in the Chinese primary stock market should buy into IPOs without VC-backing to achieve a high initial return, and investors in the secondary market should be cautious about newly listed stocks. Our results show that no obvious excess return exists within one year after the IPO, which is in line with the conjecture that more than half of first-day investors will face a loss. Funds seeking to invest in the early stages of start-ups should invest in firms with VC backing, as they will undergo IPOs earlier. Start-ups should try to obtain VC support to speed up development and to reach IPO earlier. As VC firms in China are still young and greatly value reputation, the government should continue to promote the development of the VC industry to hasten economic growth.

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