

Article

Enterprises' R&D Investment, Venture Capital Syndication and IPO Underpricing

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Abstract: Based on the data of companies that got ChiNext listed from 2009 to 2018, this paper empirically studies the relationship among R&D investment, venture capital (VC) syndication and IPO underpricing. It is found that there is a significant positive correlation between R&D investment and IPO underpricing, indicating that the higher the R&D investment is, the higher the IPO underpricing degree is; the intervention of VC syndication plays a role of “adverse selection” instead of giving play to its advantages of sharing information, which intensifies the positive correlation between R&D investment and IPO underpricing. Further analysis shows that the reputation of the leading VC in syndication can play a negative regulating role; the higher the reputation of the leading VC is, the more it can play the “certification effect”, reduce the information asymmetry caused by R&D investment, therefore alleviating the IPO underpricing caused by R&D investment.

Keywords: R&D investment; IPO underpricing; venture capital; syndication



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1. Introduction

IPO underpricing refers to the phenomenon that the initial public offering price of a stock is significantly lower than the initial market closing price of the listing, and this phenomenon is widespread in the capital market. It is generally believed that information asymmetry is one of the main reasons for IPO underpricing. In order to make up for investors who are at an information disadvantage [1,2], stock issuers will actively reduce the issuance price of stocks to promote the successful issuance of the stocks. In my country, recent study (2014) verified the impact of information asymmetry between issuers and purchasers on IPO underpricing, through empirical methods [3].

The “Thirteenth Five-Year Plan” clearly proposes to implement an “innovation-driven development strategy” to promote the sustainable development of enterprises, with technological innovation as the core. Among them, R&D activities, as an important method of innovation realization, can promote the sustainable development of enterprises, and have attracted more and more attention from policy makers and enterprises. Although R&D activities can help enterprises maintain long-term competitive advantages and keep sustainability, they will aggravate the information asymmetry in the process of investment and financing [2,4]. On this basis, many scholars have carried out research on the correlation between R&D investment and IPO underpricing, and generally believe that R&D investment will increase the degree of company IPO underpricing.

The majority of companies listed on ChiNext are high-technology companies with high growth potential, and a large number of empirical studies have shown that venture capital plays a role in signaling high-quality equity offerings in the corporate process. This is because venture capital plays a monitoring and certification role, which means venture capitalists can determine which R&D activities are more likely to be successful, and they can provide investors with accurate information about R&D investment and whether the information disclosed at the IPO is true [5]. Some scholars explore the impact of venture

capital on IPO underpricing in a sample of North African companies, arguing that a good reputation for venture capital increases managerial confidence and overvalues the true price of the stock [6]. Amit et al. argued that only those firms in bad situations tend to seek venture capital support, and venture capital-backed firms, with poor operations and quality, have relatively high IPO underpricing [7]. Elston and Yang empirically analyzed the effect of venture capital equity structure and accounting standards on IPO underpricing, using German firms as an example [8]. The findings show that venture capital has a significant effect on IPO underpricing in many countries, such as the U.S., but this finding is not confirmed in Germany. Pennacchio explored the role of venture capitalists in Italian IPO firms and concluded that firms with venture capital support have lower IPO underpricing rates compared to firms without venture capital support [9]. Gompers found that venture capitalists, especially immature venture capitalists, usually push their invested firms to IPOs earlier [10], and this improper timing of IPOs can make venture capital-backed firms have higher IPO depression rates [11]. The above studies, in general, verify that venture capitalists recognize that venture capital investment directly transmits information about the quality of IPO firms, but whether it reduces the uncertainty of R&D activities is unclear because the effect of the interaction of venture capital R&D investment on IPO underpricing is understudied.

Compared with developed countries, China's venture capital market is at a stage of development, with a small-scale and insufficient standardization. Therefore, it is still unclear whether Chinese venture capital can provide effective support and services to enterprises. However, it is undeniable that if market participants have professional technical knowledge related to R&D, their evaluations of companies will be relatively accurate. Venture capitalists have an advantage in this regard. They can conduct comprehensive investigations of technologies with high risks and high uncertainties. Therefore, given that previous studies have directly tested the impact of venture capital on IPO underpricing, various conclusions have emerged. This article intends to focus on indirect testing of the relationship between venture capital and IPO underpricing, and examine the impact of venture capital on R&D investment and IPO underpricing. Does underpricing have a regulatory effect?

Venture capital syndication is an investment behavior involving many venture capital institutions, which often participate in the equity financing of high-tech enterprises before going public. Compared with individual VC, syndication can not only provide more value-added services for the growth of enterprises [12], but also deliver good market signals through the authentication and supervision functions, so it is accepted by more and more IPO companies. However, VC syndication may also lead to "free rider" behavior and aggravation of the type II agency cost [13], which are both potential factors that trigger information asymmetry in the stock market. Then, as one of the ways of VC investment, will syndication affect the effect of R&D investment on IPO underpricing after entering the enterprise? How do the different characteristics of VC syndication affect them?

Most of the companies listed on ChiNext are high-tech companies. Compared with the main board, and small- and medium-sized companies, they invest more in R&D. Therefore, there is a higher information asymmetry. Whether this asymmetry, caused by R&D investment, will lead to higher IPO underpricing for ChiNext companies is a question worthy of attention. Venture capital, as a professional investment institution, often participates in equity financing of high-tech companies before listing. Joint investment is a syndication of venture capital; due to its good risk dispersion and resource sharing advantages, it is mostly adopted by venture capital institutions. Joint investment is naturally related to the R&D activities of enterprises. Whether its intervention has a moderating effect on the relationship between R&D investment and IPO underpricing, and whether the different characteristics of joint investment will also cause different effects, are issues worthy of discussion and research.

This article takes the companies successfully listed on ChiNext from 2009 to 2018 as a sample, and uses the literature method and empirical method to study the following issues:

(1) the impact of corporate R&D investment on IPO underpricing; (2) the moderating effect of VC syndication between corporate R&D investment and IPO underpricing; (3) the moderating effect of VC syndication on corporate R&D and IPO underpricing depends on the characteristics of it. The innovation of this paper mainly lies in the following: (1) The use of the latest data. In 2014, China began to impose a limit on the rise and fall of new shares. Therefore, it is impossible to use the closing price on the first day of listing after 2014 as the basis for calculating the IPO underpricing rate. This article uses the average of the closing prices on the 5th and 10th day of listing as the calculation of IPO underpricing. The basis of the price rate makes the research results more able to reflect the actual situation in China at present. (2) The selection of adjustment variables is novel. Innovatively introduce VC syndication as a moderating variable between enterprise R&D investment and IPO underpricing, and then further explore whether the length and reputation of leading VC will play a different degree of moderating effect. The previous research on the three variables of R&D investment, VC syndication and IPO underpricing has been expanded to make it more complete.

2. Hypothesis Development

2.1. *Analysis on the Impact of Enterprise R&D Investment on IPO Underpricing*

One of the main reasons for IPO underpricing is the existence of information asymmetry. The information asymmetry between companies and external investors makes companies send a good signal to the external market, by lowering the stock issue price, leading to increased IPO underpricing [14]. The asymmetry of information among investors has led to a “winner’s curse”. In order to retain uninformed investors, companies underpricing to issue stocks also increase IPO underpricing.

Although R&D investment has a positive effect on corporate performance and market value, as part of the corporate disclosure of information, scholars generally find that R&D information can also aggravate the information asymmetry between enterprises and external investors, and among investors [15,16].

2.1.1. Information Asymmetry between Companies and External Investors Caused by R&D Investment

The information asymmetry between enterprises and external investors can be analyzed from the following three perspectives: (1) the degree of information disclosure; (2) the characteristics of R&D activities; and (3) accounting treatment methods.

From the perspective of the degree of information disclosure of R&D investment, there are the following two problems: one is incomplete disclosure of the information, and the other is incomplete information. The standards do not make clear and mandatory provisions for companies to disclose their R&D investment information. Therefore, many companies directly ignore the disclosure of R&D information. The incompleteness of the disclosed information is not conducive to the judgment of external information users on the value of the enterprise, and will further aggravate information asymmetry [15].

From the perspective of the characteristics of R&D activities, the important role of enterprise R&D activities is to improve the process or output of innovation activities, and the long-term nature of R&D investment is destined to not bring immediate benefits to the enterprise, which makes the R&D investment increase the uncertainty about whether it can provide added value. The uncertainty of the future value growth of enterprises will lead to extremely high IPO underpricing [17,18].

From the perspective of accounting treatment, the expense of R&D investment not only leads to the reduction in the earnings management efficiency of enterprises, but also leads to the reduction in balance sheet accuracy, which affects the judgment of external statement users, may make the enterprise value be underestimated, and increases the IPO underpricing degree.

2.1.2. Information Asymmetry among Investors Caused by R&D Investment

The “winner’s curse” theory was first proposed by Rock [1]. He believed that during the issuance of new shares, investors in the market have different information grasps for each company in the market, due to their own circumstances and their ability to obtain information. There are the following two different types of investors in the market: insiders, with information advantages, and non-informers, with information disadvantages. Because the insiders have more knowledge about the company’s information, they will only buy the low-priced stocks during the IPO process. As for the uninformed, who are at an information disadvantage, it is often easier to buy stocks with an issue price higher than their true value, because they cannot identify stocks with a low issue price. Uninformed persons are at risk of adverse selection. In reality, the uninformed can also recognize the risks they face and demand compensation for the risks, while the issuer will take the initiative to lower the issuance price of the stock for the success of the stock issuance, and take measures against the risks faced by the uninformed.

Beatty and Ritter conducted further research and proposed that the degree of uncertainty in the company’s value will affect the company’s IPO underpricing [2]. The greater the uncertainty of the company’s value, the more serious the company’s IPO underpricing. It is mainly based on the “winner’s curse” hypothesis, which believes that the greater the degree of uncertainty in the value of an enterprise, the greater the proportion of uninformed persons who are at an information disadvantage, and the greater the information uncertainty they face. At this time, there are only two choices for the uninformed person who are at an information disadvantage. Either collect information to solve the risks caused by information uncertainty, or settle on the status quo and bear the risks caused by information uncertainty. In order to further reduce the cost of the company to investors and make up for the increased risk of investors, the issuing company will further reduce the cost of stock issuance, thereby triggering a higher IPO underpricing. In response to the “winner’s curse” theory, Chinese scholars have also carried out corresponding verifications, based on data from the Chinese market. Zhang and Lu used 859 companies listed from 2000 to May 2010 as samples to compare Rock’s “winners’ curse” theory [3]. Empirical testing of the theory of “the curse of the person”, and the risk hypothesis of the Ritter and Beatty study found that, overall, these two theories are effective in the Chinese market.

Regarding the information asymmetry among investors, according to the “winner’s curse” hypothesis, compared with the non-informers, the insiders of the company, such as inquiry agencies, underwriters, and external related parties, have a better understanding of the direction and content of the company’s R&D investment, process and impact on corporate performance. With the increase in R&D investment, the degree of information asymmetry between insiders and non-informers will increase further [1].

In summary, this article proposes the following assumptions:

H1: Companies with higher R&D investment have higher IPO underpricing.

2.2. Analysis on the Moderating Effect of VC on R&D Investment and IPO Underpricing

Venture capital plays the following two main roles in the IPO process of participating enterprises: certification supervision and opportunism.

2.2.1. The Influence of VC on R&D Investment and IPO Underpricing When It Plays the Role of Certification Supervision

Under the role of the certification and supervision of VC, the role of the certification and supervision of VC will weaken the positive relationship between R&D investment and IPO underpricing. The reasons include the following: (1) the participation of VC gives the market more confidence in the quality of IPO companies [19,20]; (2) VC will supervise the company’s R&D investment and other information disclosure, thereby reducing the degree of information asymmetry [21]; (3) VC and innovation have a natural link. VC can provide value-added services to companies in various aspects, such as corporate strategic decision-

making, thereby reducing the possibility of corporate R&D failures and the information asymmetry caused by the R&D activity itself [22].

2.2.2. The Impact of Venture Capital on R&D Investment and IPO Underpricing When It Plays an Opportunistic Role

With venture capital playing an opportunistic role, the participation of VC will strengthen the positive relationship between the intensity of R&D investment and IPO underpricing. The possible reasons are as follows: (1) VC is eager to improve its reputation through listing, and the addition of venture capital will increase the pre-IPO earnings management and whitewash the company's financial statements [23]. In this case, the degree of information asymmetry between IPO companies and investors has increased; (2) in the case of VC playing an opportunistic role, external investors in the market will have adverse selection of venture capital behaviors, thereby magnifying the positive relationship between R&D investment and IPO underpricing.

To sum up, this paper proposes the following assumptions:

H2a: The involvement of venture capital will weaken the positive correlation between R&D investment and IPO underpricing.

H2b: The involvement of venture capital will enhance the positive correlation between R&D investment and IPO underpricing.

2.3. Analysis of the Regulatory Effect of VC Syndication on R&D and IPO Underpricing

There are two completely opposite views on the relationship between joint investment and IPO underpricing. Each participant in the syndication has their own unique professional knowledge, information and different industry insights. The syndication can share resources, reduce investment risks, and provide enterprises with more value-added services [12]. Moreover, due to the existence of the network effect, the syndication can further certify the value of the enterprise, reduce the information asymmetry between the enterprise and external investors, and reduce IPO underpricing [24]. Although the advantages of VC syndication are obvious, the disadvantages are also obvious. There will be a "free-rider" phenomenon within the VC syndication [25]. The existence of VC syndication may also lead to an increase in coordination costs, leading to an increase in the cost of the type II agency.

2.3.1. The Influence of Venture Capital Syndication on R&D Investment and IPO Underpricing When Exerting Network Effects

When venture capital syndication can take advantage of its network effect, venture capital within the consortium can share information and resources, which can provide the companies with the necessary industry experience and expertise. At the same time, when syndication exerts a network effect, it can reduce the opportunistic tendency of venture capital. Its participation in the formation of a consortium can show that it is optimistic about the R&D investment of the invested company, and reduces the R&D investment. The resulting uncertainty in corporate value weakens the asymmetry of information caused by R&D investment [26,27], thereby certifying corporate R&D investment.

2.3.2. The Impact of Venture Capital Syndication on R&D Investment and IPO Underpricing When It Is Inclined to Opportunism

When VC syndication cannot give full play to its advantages, the existence of syndication may intensify the positive correlation between R&D investment and IPO underpricing. The specific analysis is as follows: (1) Under the risk of opportunistic investment, the syndication will further package the company's R&D investment information, and increase the earnings management of the invested company before IPO [28–30], thereby intensifying the R&D information asymmetry caused by investment, and increasing the degree of IPO underpricing. (2) The "free-rider" behavior of venture capital syndication will lead to a decrease in the sense of responsibility and participation of venture capital institutions,

and the need to coordinate the interests of all parties in the joint investment institution, resulting in aggravation of the agency problem, and the syndication will not be able to effectively exert its supervision and management [31,32]. Also, the value-added function provides effective support for the enterprise's R&D activities, and cannot alleviate the uncertainty of value caused by R&D investment. Therefore, hypotheses H3a and H3b are proposed.

H3a: The participation of VC syndication will weaken the positive correlation between R&D investment and IPO underpricing.

H3b: The participation of VC syndication will intensify the positive correlation between R&D input and IPO underpricing.

3. Research Development

3.1. Data and Variable

3.1.1. Data Sources

The research and development data from the 1 to 3 years before the IPO and the current period are manually compiled from the company's annual report and prospectus; the company's closing price data on the first day of listing are taken from the Wind database. VC syndication investment data and corporate IPO-related data are all taken from the Zero2IPO database. Corporate financial data are taken from the CSMAR database and Wind database. The performance and underwriting business-ranking data of securities companies are taken from the website of the Securities Industry Association of China.

3.1.2. Variable

Explained variable: The IPO underpricing rate of the ChiNext companies on the first day of listing is selected as the explained variable, to measure the degree of IPO underpricing. It has two calculation methods. One is to follow the approach of Ritter [2], which is defined as the closing price of the first day of listing minus the issuance price of new shares, and then divided by the issuance price of new shares; the other is based on the above calculation, further eliminating market fluctuation. The affected IPO underpricing rate is defined as the underpricing rate minus the market rate of return on the day. In this paper, the IPO underpricing rate (UPR) under the first algorithm is used as the explained variable of the main test, and the adjusted IPO underpricing rate (Adj_UPR) under the second algorithm is used as the replacement variable in the robustness test. Prior to June 2014, my country's stock issuance adopted a relatively flexible inquiry method, and there were basically no price limits on the first day of IPOs; since July, IPOs have adopted primary market price control and the secondary market's first-day limit price joint mechanism arrangements. Therefore, in order to better measure the initial market transaction price, the average value of the closing price on the 5th and 10th day of listing is selected as the basis for calculating the IPO underpricing rate for companies under the new time limit; this was launched in December, using the Shenzhen component index as the basis for calculating the market return rate of the day.

Explanatory variables: The level of R&D investment (RD) is measured by the ratio of R&D investment to operating income. Considering that the R&D activities of enterprises are cyclical and have a lagging effect on the value of the enterprise, the R&D data of the current period, the first period, the second period and the third period are used for regression. Venture capital (VC) and joint investment (Syn) are dummy variables. When a company has venture capital in any round of financing, it is defined as one, otherwise it is zero; the definition of joint investment variables is the same. Co-investment investment time (Int) refers to the practice of Wang Huijuan and Zhang Ran [33], and is measured by the logarithm of the number of months between the time of co-investment and the company's listing; if there are multiple rounds of co-investment, the earliest participation time is calculated as a starting point. The reputation of leading VC in syndication (Rep) refers to Lee [34–36]. It is measured by the logarithm of the number of months between the

establishment of the leading venture capital institution and the investment in the startup company, based on the time when the co-investment first appeared.

Control variables: Existing research shows that factors such as investor sentiment, underwriter's reputation, company size, and issuance scale will all affect the degree of IPO underpricing. Therefore, company age (AGE), issuance size (PROC), company size (SIZE), and underwriting are selected. Commercial reputation (UR), winning rate (PL), turnover rate (TURV), financial risk (LEV), and return on total assets (ROA) are used as control variables. Among them, the winning rate (PL) and the turnover rate (TURV) are used to measure investor sentiment in the primary and secondary markets; financial risk (LEV) and return on total assets (ROA) are measured from two dimensions of risk and return. They reflect the financial status and operation capability of the companies. In addition, industry and year variables are selected to control the influence of different industries and years.

This paper sets a series of variables, which are shown in Table 1.

Table 1. Meaning and measurement of variables.

Symbol	Meaning	Measurement
UPR	IPO Underpricing Rate	Before June 2014: (closing price on the 1st day of listing—IPO price)/IPO price; After June 2014: (average closing price on the 5th and 10th of listing—IPO price)/IPO price
Adj_UPR	IPO Underpricing Rate Adjustment	UPR—Market return on the day
RD ₀	R&D Investment (current)	R&D investment in the current listing period as a percentage of main business income
RD ₁	R&D Investment (lag one period)	The ratio of R&D investment to main business income 1 year before listing
RD ₂	R&D Investment (lag two period)	The ratio of R&D investment to main business income 2 year before listing
RD ₃	R&D Investment (lag three period)	The ratio of R&D investment to main business income 3 year before listing
VC	Venture Capital	VC participation takes the value 1, otherwise it is 0
Syn	VC Syndication	Two or more VC participating in the value is 1, otherwise it is 0
Int	Time of Leading VC	ln (the number of months between the time of equity participation and the listing of the company)
Rep	Reputation of Leading VC	ln (number of months between the establishment of the leading venture capital institution and the investment in the startup company)
RD × Int	Crossover Term	Multiply the R&D investment in each period by the holding time of the leading VC
RD × Rep	Crossover Term	R&D investment in each phase × the reputation of leading VC
AGE	Company Age	ln (company listing year—year of company establishment +1)
PROC	Issue Size	ln (actual net funds raised)
SIZE	Company Size	ln (total company assets in the year before listing)
PL	Winning Rate	Primary market subscription success rate
TURV	Turnover Rate	Turnover rate of stocks on the first day of listing
LEV	Financial Risk	Asset–liability ratio one year before listing
ROA	Return On Total Assets	Return on total assets of the company at the end of the year before listing
UR	Underwriter's Reputation	Take 1 for the top 10 lead underwriters, otherwise take 0
Year	Year	1 in the current year of IPO, 0 otherwise
Industry	Industry	Belongs to the industry is 1, otherwise it is 0

3.2. Methodology

3.2.1. Sample Selection

This article selects the companies successfully listed on ChiNext from 2009 to 2018 as the research sample. After excluding ST and the financial and insurance industries, delisted companies, and companies with missing R&D data, 715 valid samples are obtained, which can ideally achieve the research purpose and improve study validity. First, the mandatory disclosure of R&D investment by ChiNext enterprises when they are listed ensures the availability and stability of data; secondly, ChiNext enterprises are mostly high-tech companies, which are more typical, with concentrated industries and similar

enterprise scales, and effectively reduced the error caused by industry and scale. Finally, venture capital has a higher degree of participation in ChiNext enterprises.

3.2.2. Model

In order to study the impact of corporate R&D investment on the degree of IPO underpricing, based on the research of Fu Leiming et al. [20,37], the model is constructed as follows:

$$UPR/Adj_UPR = \alpha_0 + \alpha_1 RD + \alpha_2 AGE + \alpha_3 PROC + \alpha_4 SIZE + \alpha_5 PL + \alpha_6 TURV + \alpha_7 LEV + \alpha_8 ROA + \alpha_9 UR + \sum Year + \sum Industry + \varepsilon \quad (1)$$

In Equation (1), *UPR* and *Adj_UPR* respectively represent the IPO underpricing rate before and after adjustment; *RD* represents the company's R&D investment (current and lagging one, two, and three periods); the rest are control variables; ε is the error term. α_1 measures the net effect of a firm's R&D investment on the degree of IPO underpricing, and its significant regularity hypothesis H1 is verified.

Continuing to apply Equation (1), this article groups the companies listed on the ChiNext according to the presence or absence of venture capital and syndication, and examines the impact of R&D investment on the degree of IPO underpricing under the participation of venture capital and syndication, and then to test H2a and H2b, and H3a and H3b.

4. Result

4.1. Descriptive Statistical Analysis

It can be seen from Table 2 that the average IPO underpricing rate before and after the adjustment is around 38%, which is significantly higher than the level of developed countries, indicating that my country's ChiNext companies have relatively serious IPO underpricing. Among the companies with venture capital investment, 62.9% are invested by venture capital syndication, indicating that syndication accounts for a relatively large proportion of venture capital, which again confirms the necessity of this article. The average winning rate is 0.8%, and a low rate indicates that investors in the primary market are more enthusiastic. On the whole, ChiNext companies have relatively good profitability before listing, with an average return on assets of 15%.

Table 2. Variable descriptive statistics.

Variables	Observations	Average	Standard Deviation	Minimum	Max
UPR	715	0.384	0.337	−0.121	1.556
Adj_UPR	715	0.377	0.327	−0.077	1.476
RD ₀	715	0.064	0.045	0.007	0.256
RD ₁	715	0.060	0.038	0.004	0.218
RD ₂	715	0.063	0.045	0.006	0.295
RD ₃	715	0.064	0.046	0.003	0.283
VC	499	0.698	0.4607	0.000	1.000
Syn	314	0.629	0.485	0.000	1.000
AGE	715	2.388	0.532	0.693	3.219
PROC	715	10.51	0.660	9.254	12.278
SIZE	715	19.83	0.656	18.523	21.779
PL	715	0.008	0.010	0.000	0.056
TURV	715	0.343	0.376	0.000	0.920
LEV	715	0.379	0.150	0.063	0.711
ROA	715	0.150	0.073	0.032	0.396
UR	715	0.404	0.491	0.000	1.000

4.2. Regression Analysis

4.2.1. Analysis of the Impact of R&D Investment of Listed Companies on the Growth Enterprise Market on the IPO Underpricing Rate

First, based on the full sample data, Equation (1) is used to test the impact of the R&D investment (RD) of the listed companies on ChiNext, based on the IPO underpricing rate. The regression results are shown in Table 3. Among them, results (1) to (4), respectively, represent the impact of R&D investment in the current period, the previous period, the first two periods, and the first three periods.

Table 3. Full sample regression results (the influence of R&D investment on the IPO underpricing rate).

Variables	UPR			
	(1)	(2)	(3)	(4)
RD ₀	0.622 (2.29)			
RD ₁		0.711 (2.04)		
RD ₂			0.908 (3.14)	
RD ₃				0.611 (2.50)
AGE	0.002 (0.11)	0.005 (0.23)	0.006 (0.30)	0.013 (0.67)
PROC	−0.197 (−5.94)	−0.189 (−5.70)	−0.189 (−5.67)	−0.187 (−5.84)
SIZE	−0.100 (3.01)	−0.091 (2.79)	−0.093 (2.80)	−0.087 (2.73)
PL	−4.946 (−4.94)	−4.885 (−4.90)	−4.995 (−5.02)	−5.147 (−5.27)
TURV	0.731 (9.21)	0.721 (9.24)	0.717 (9.28)	0.747 (9.48)
LEV	−0.111 (−1.32)	−0.113 (−1.36)	−0.111 (−1.35)	−0.137 (−1.76)
ROA	0.376 (1.77)	0.347 (1.64)	0.369 (1.76)	0.413 (2.11)
UR	−0.019 (−1.02)	−0.023 (−1.24)	−0.022 (−1.24)	−0.025 (−1.33)
Cons	0.207 (0.46)	0.306 (0.69)	0.270 (0.61)	0.575 (1.39)
N	715	715	715	715
Adj. R ²	0.492	0.501	0.509	0.474
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes

As can be seen from Table 4, there is a significant positive correlation between the R&D investment of ChiNext-listed companies and IPO underpricing rate, indicating that the higher the R&D investment of ChiNext-listed companies is, the higher the IPO underpricing rate will be, and the more serious the underpricing degree will be. Hypothesis H1 has been verified. By studying the coefficient and significance of the control variables, it can be seen that IPO underpricing rate is negatively correlated with the issue size and company size of enterprises at the significance level of 1%, indicating that the larger the issue size and asset size of enterprises are, the lower the IPO underpricing rate will be. Similarly, the successful endorsement rate also has a significant inhibitory effect on the IPO underpricing rate. The turnover rate on the first day of listing is significantly positively correlated with the IPO underpricing rate, indicating that higher investor sentiment in the secondary market can promote IPO underpricing degree.

Overall, the IPO underpricing rate is not significantly related to the profitability of the company.

4.2.2. Analysis of the Impact of VC Investment on R&D Investment and IPO Underpricing

In order to verify the hypotheses H2a and H2b, on the basis of Model (1), the data are grouped into risky investment and non-risky investment, and are then tested. The regression results are shown in Table 4. Among them, VC = 0 and VC = 1, respectively, indicate whether there is risk investment in the current period.

Table 4. Group regression results based on the presence or absence of VC (the impact of R&D investment on the IPO underpricing rate).

Variables	UPR							
	VC = 0 (1)	VC = 1 (2)	VC = 0 (3)	VC = 1 (4)	VC = 0 (5)	VC = 1 (6)	VC = 0 (7)	VC = 1 (8)
RD0	−0.188 (−0.43)	0.853 −2.97						
RD1			−0.238 (−0.45)	1.014 −3.08				
RD2					0.185 −0.39	1.173 −4.37		
RD3							0.393 −0.91	0.492 −1.8
N	216	499	216	499	216	499	216	499
Adj. R ²	0.613	0.47	0.612	0.474	0.612	0.487	0.614	0.468
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

In order to verify the hypotheses H2a and H2b, the regression test is performed with Model (1). This is because the purpose of the test is to verify whether the venture capital will enhance the positive correlation between R&D investment and IPO underpricing or not; the data are divided into two groups, with VC investment and without VC investment, so group inspection is carried out. From the regression results in Table 4, it can be seen that there is a significant positive correlation between R&D investment and IPO underpricing in companies with venture capital. There is no obvious relationship between R&D investment and IPO underpricing in companies that do not have venture capital. The grouped T test between the two groups has passed the significance at the 5% level, except for the data of the R&D investment, which lag the third period. This shows that the involvement of venture capital has strengthened the relationship between corporate R&D investment and IPO underpricing, and verified the correctness of hypothesis H2b. The coefficient results of the remaining financial indicators are basically consistent with Table 3.

4.2.3. Analysis of the Impact of the R&D Investment of ChiNext Enterprises on the IPO Underpricing Rate with VC Syndication Participation

In order to further study the moderating effect of VC syndication on corporate R&D investment and IPO underpricing, companies with a joint investment background and companies with venture capital, but no joint investment, are grouped, and the hypotheses H3a and H3b of this article are verified by group testing. The regression results are shown in Table 5, where Syn = 0 and Syn = 1, respectively, indicate whether there is joint investment in the current period.

It can be seen from Table 5 that the moderating effect of VC syndication between the company's R&D investment and the IPO underpricing rate is the current R&D investment, the one-stage R&D investment, the two-stage R&D investment and the three-stage delay. There is a significant positive correlation between the IPO underpricing rate and the R&D investment in the current period of the companies that have VC syndication; while in the IPO underpricing rate of the companies that do not have VC syndication, there

is no significant correlation with the current R&D investment. The regression results prove the correctness of hypothesis H3b. The coefficient results of the remaining financial indicators are basically consistent with Table 3. The results of the above comprehensive analysis show that the involvement of VC syndication has not played a regulatory role between the investors and enterprises, nor has it played a corresponding supervisory role. On the contrary, it has increased the information asymmetry between the investors and enterprises, and, further, the positive correlation between increased R&D investment and IPO underpricing rate has made the IPO underpricing caused by R&D investment more serious.

Table 5. Group regression results based on the presence or absence of VC syndication (the impact of R&D investment on the IPO underpricing rate).

Variables	UPR							
	Syn = 0 (1)	Syn = 1 (2)	Syn = 0 (3)	Syn = 1 (4)	Syn = 0 (5)	Syn = 1 (6)	Syn = 0 (7)	Syn = 1 (8)
RD ₀	−0.188 (−0.43)	1.125 −3.4						
RD ₁			−0.238 (−0.45)	1.344 −3.6				
RD ₂					0.185 −0.39	1.347 −4.57		
RD ₃							0.393 −0.91	0.735 −2.3
N	185	314	185	314	185	314	185	314
Adj. R ²	0.613	0.46	0.612	0.462	0.612	0.477	0.614	0.451
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

4.3. Further Research

In order to explore the moderating effect of different characteristics of VC syndication on R&D investment and IPO underpricing, this paper further considers the shareholding duration and reputation of leading VC.

4.3.1. Theoretical Analysis

In VC syndication, a venture capital institution usually plays the role of the leading institution. Its participation is the highest and the most active in syndication. Generally, the leading VC is responsible for the internal coordination of syndication, which is decisive for the strategic choice of syndication. Due to its special status and role, the different characteristics of leading venture capital may play a different role in the adjustment of R&D investment and IPO underpricing. The article mainly selects two characteristics of investment duration and reputation for research.

1. An analysis of the impact of R&D investment that leading VC's holding duration and participates in the regulation on the IPO underpricing;

Leading VC can be divided into two types according to the different investment time points. One is in the early days of the company's establishment, and the other is a venture capital institution that rushes to buy shares when the company is about to go public. For the first type of venture capital institutions, who generally already have a complete internal organizational structure and a good investment reputation, their shareholding is a positive signal to the capital market to reduce the degree of IPO underpricing [38]. The second type of investment institution has a strong name-by-name motive, and the most effective way to build a reputation is to list the company as soon as possible (Gompers, 1996). Based on the above analysis, the following hypotheses are proposed:

H3c: The longer the holding time of the leading VC, the more beneficial it is to weaken the degree of positive correlation between R&D investment and IPO underpricing.

2. An analysis of the impact of R&D investment in the moderating of leading VC's reputation participation on IPO underpricing;

A high-reputation VC will carefully select investment projects in order to maintain its own reputation. After entering the project, it will also use its own professional knowledge and experience to effectively participate in the management of the company, and provide the company with the value-added services. For low-reputation VC, in order to obtain financing and successfully exit to earn excess returns, it needs to release signals to the outside to resolve the information asymmetry between VC and its investors. At the same time, VCs with low reputations are often younger and lack experience and industry knowledge [10,39]. Therefore, this article proposes the following hypothesis:

H3d: The higher the reputation of the leading VC, the more helpful it is to alleviate the IPO caused by the company's R&D investment.

4.3.2. Methodology

In order to study the moderating effect of leading VC investment duration on the relationship between corporate R&D investment and IPO underpricing, the model is constructed as follows:

$$\begin{aligned} UPR/Adj_UPR = & \beta_0 + \beta_1 RD + \beta_2 Int + \beta_3 RD \times Int + \beta_4 AGE + \beta_5 PROC + \beta_6 SIZE \\ & + \beta_7 PL + \beta_8 TURV + \beta_9 LEV + \beta_{10} ROA + \beta_{11} UR + \sum Year \\ & + \sum Industry + \varepsilon \end{aligned} \quad (2)$$

In order to study the role of leading VC's reputation in the adjustment of corporate R&D investment between corporate R&D investment and IPO underpricing, the model is constructed as follows:

$$\begin{aligned} UPR/Adj_UPR = & \gamma_0 + \gamma_1 RD + \gamma_2 Rep + \gamma_3 RD \times Rep + \gamma_4 AGE + \gamma_5 PROC + \gamma_6 SIZE \\ & + \gamma_7 PL + \gamma_8 TURV + \gamma_9 LEV + \gamma_{10} ROA + \gamma_{11} UR + \sum Year \\ & + \sum Industry + \varepsilon \end{aligned} \quad (3)$$

In Equations (2) and (3), $RD \times Int$ and $RD \times Rep$, respectively, represent the cross-productivity of the company's R&D investment, and the duration and reputation of leading VC investment. β_3 and γ_3 , respectively, measure the moderating effect of duration and reputation between corporate R&D investment and IPO underpricing. If β_3 and γ_3 are both significantly negative, hypotheses H3c and H3d are verified. The remaining variables are the same as Equation (1).

4.3.3. Regression Result

Add the multiplication item ($RD \times Int$) of the R&D investment and the holding time of the leading VC, and use the IPO underpricing rate and the adjusted IPO underpricing rate as the dependent variables to regress. The results are shown in Tables 6 and 7.

It shows that the length of holding time of the leading venture capital cannot play a negative role in regulating the relationship between R&D investment and IPO underpricing. Hypothesis H3c cannot be verified. The explanation for this is that under the current system and market environment in China, venture capital participating in the management of companies will be regarded as interference with the company's operations, so they rarely participate in the management of companies, even if they hold the company's management for a long time. Equity does not participate too much in the management of the company, and exerts its supervision and management functions. Therefore, the holding time of the leading VC in syndication does not play a role in reducing the positive correlation between R&D investment and IPO underpricing.

Table 6. Regression results of the moderating effect of leading VC holding duration on IPO underpricing rate.

Variables	UPR			
	(1)	(2)	(3)	(4)
RD ₀	1.087 (2.09)			
RD ₀ × Int	−0.293 (−0.42)			
RD ₁		1.345 (2.25)		
RD ₁ × Int		−0.613 (−0.76)		
RD ₂			1.571 (3.54)	
RD ₂ × Int			−0.949 (−1.67)	
RD ₃				1.014 (1.52)
RD ₃ × Int				−0.631 (−0.71)
Int	0.028 (0.78)	0.036 (1.01)	0.039 (1.12)	0.035 (0.97)
N	314	314	314	314
Adj. R ²	0.481	0.485	0.516	0.481
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes

Table 7. Regression results of the moderating effect of leading VC holding duration on the adjusted IPO underpricing rate.

Variables	Adj_UPR			
	(1)	(2)	(3)	(4)
RD ₀	1.165 (2.23)			
RD ₀ × Int	−0.303 (−0.43)			
RD ₁		1.379 (2.33)		
RD ₁ × Int		−0.592 (−0.74)		
RD ₂			1.569 (3.59)	
RD ₂ × Int			−0.909 (−1.59)	
RD ₃				1.044 (1.60)
RD ₃ × Int				−0.641 (−0.72)
Int	0.035 (1.01)	0.044 (1.27)	0.047 (1.38)	0.043 (1.24)
N	314	314	314	314
Adj. R ²	0.458	0.462	0.492	0.457
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes

Add the crossover item (RD × Rep) of the R&D investment and leading VC reputation, and regress with IPO underpricing rate and adjusted IPO underpricing rate as dependent variables, respectively. The results are shown in Tables 8 and 9.

Table 8. The regression result of the leading VC's reputation on IPO underpricing.

Variables	UPR			
	(1)	(2)	(3)	(4)
RD ₀	1.956 (2.12)			
RD ₀ × Rep	−4.132 (−2.08)			
RD ₁		2.270 (2.26)		
RD ₁ × Rep		−7.290 (−2.43)		
RD ₂			2.438 (3.50)	
RD ₂ × Rep			−7.756 (−3.00)	
RD ₃				1.653 (1.78)
RD ₃ × Rep				−4.581 (−1.51)
Rep	−0.035 (−0.27)	−0.040 (−0.32)	−0.033 (−0.32)	−0.113 (−0.88)
N	314	314	314	314
Adj. R ²	0.521	0.549	0.687	0.510
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes

Table 9. The regression result of the leading VC's reputation on adjusted IPO underpricing.

Variables	Adj_UPR			
	(1)	(2)	(3)	(4)
RD ₀	1.956 (2.09)			
RD ₀ × Rep	−4.533 (−2.25)			
RD ₁		2.119 (2.07)		
RD ₁ × Rep		−7.899 (−2.59)		
RD ₂			2.279 (3.16)	
RD ₂ × Rep			−8.258 (−3.08)	
RD ₃				1.512 (1.60)
RD ₃ × Rep				−5.093 (−1.65)
Rep	−0.025 (−0.19)	−0.031 (−0.25)	−0.025 (−0.24)	−0.106 (−0.81)
N	314	314	314	314
adj. R ²	0.481	0.508	0.646	0.464
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes

There is a significant negative correlation between R&D investment and the reputation of leading venture capital investment, IPO underpricing and adjusted IPO underpricing, indicating that the higher reputation that the leading venture capital has, the better it is to alleviate the IPO underpricing caused by the R&D investment of the company, suppose H3d is verified. The higher the reputation of the leading venture capital, the smaller the

motivation to pursue reputation, and its own high reputation can also achieve certification for the company, alleviate the information asymmetry caused by R&D investment, and reduce the company's IPO underpricing.

4.4. Robustness Test

In order to ensure the reliability of the research, the following robustness test analysis is further carried out: (1) considering the influence of the market rate of return on the IPO underpricing rate, the IPO underpricing rate adjusted by the market rate of return is further used for the robustness test; (2) change the non-adjusted IPO underpricing rate to the IPO underpricing rate, adjusted by the market rate of return, and grouped with or without the participation of risk investment; (3) using the adjusted IPO underpricing rate indicator, examine the effect of joint investment on the company grouping the adjustment effects between R&D investment and IPO underpricing. Repeat the above steps to perform empirical regression analysis on the original model, and the research conclusion has not changed substantially, thus confirming the robustness of the research.

5. Conclusions and Suggestions

5.1. Conclusions

This article uses the 2009–2018 ChiNext-listed companies as a sample to study the relationship between R&D investment and IPO underpricing, and on this basis it examines the regulatory role of venture capital. Furthermore, this article combines the role of investment duration and reputation of the leading venture capital in joint investment, to further examine the relationship between R&D investment and IPO underpricing.

The research found the following: (1) R&D investment has increased the information asymmetry between the company and external investors, and within investors. In order to release good corporate information to external investors, companies will deliberately lower the stock issue price, leading to an increase in IPO underpricing. The higher, that is, the more R&D investment, the more serious the IPO underpricing of enterprises; (2) The addition of venture capital does not play a role in certification and supervision, but more shows the “name-by-name effect”, pushing immature companies to go public. It increased the degree of IPO underpricing, that is, venture capital intensified the degree of IPO underpricing caused by R&D investment; (3) Joint investment does not exert network effects, but has more “adverse selection” effects, plus the type II of agency costs. The increase in the value of R&D investment has increased the uncertainty of the value of enterprises' R&D investment, aggravated information asymmetry, and has led to higher IPO underpricing, that is, the intervention of joint investment increases the positive correlation between R&D investment and IPO underpricing; (4) The holding time of the leading venture capital cannot weaken the positive correlation between R&D investment and IPO underpricing, while the reputation of the leading venture capital can play a certain role. The higher the reputation of the leading venture capital, the higher the reputation pursuit. Motivation will be weakened, and its own high reputation can also play a role in value certification for invested companies, alleviate the information asymmetry caused by R&D investment, and reduce the positive correlation between R&D investment and IPO underpricing.

5.2. Suggestions

First, increase the degree of disclosure of R&D investment information. Under China's current policies, companies simply disclose the amount of R&D investment and its percentage of operating income, and disclosure specific projects and current results less. This has led to an increase in information asymmetry between companies and external investors, and has intensified the degree of IPO underpricing of enterprises. Enterprises should disclose R&D information purposefully, provide sufficient R&D information, and reduce information asymmetry caused by R&D investment.

Second, when the invested company introduces joint investment, it should try its best to choose an investment institution with a higher reputation. In this way, the par-

ticipation of venture capital can play a positive role in certification, alleviate the higher IPO underpricing caused by R&D investment in enterprises, and raise more funds for enterprises.

Third, increase the training of professional investment personnel. Draw lessons from foreign advanced management experience and talent training models. At the same time, the supervisory level should increase the regulation and management of existing practitioners, so that venture capital institutions can get rid of opportunism and give more play to their certification, and supervision and management functions.

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