



Are Green Technology Enterprises More Attractive to Venture Capital? Based on the Empirical Study of Listed Companies on GEM in China

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Abstract

Venture capital is an important channel for enterprises to relieve the financing pressure of technological innovation activities. It is of great significance to evaluate the impact of green technology and non-green technology signals on venture capital to promote green development in China. Thus, this paper takes the GEM listed companies from 2009 to 2020 as samples to analyze whether venture capital has a preference for the "green technology" of enterprises from the perspective of technological innovation. It is found that compared with non-green technology enterprises, green technology enterprises are more likely to obtain venture capital, and the enterprise scale, asset-liability ratio, the proportion of the largest shareholder and the state-owned nature of the enterprise will affect the possibility of obtaining venture capital.

Keywords: *venture capital, green technology, preference*

1. INTRODUCTION

In recent years, China attaches great importance to green technology innovation, and clearly proposes to build a market-oriented green technology innovation system. With the strong support of policies, although China's green technology innovation level has been significantly improved, and special actions in energy conservation, emission reduction, low-carbon environmental protection and cleaner production have achieved remarkable results, green technology enterprises still face serious capital constraints, which will inevitably affect green development.

Venture capital (VC) is considered as the most suitable financing source for high-tech enterprises. According to the Zero2IPO Research Center, there were 2,893 investment cases disclosed in China's venture capital market in 2020, with a total amount of RMB 195.264 billion. Among them, the investment scale of China's clean technology industry showed an overall upward trend from 2014 to 2020, and green technology has attracted investors' attention. However, China's green technology innovation is still in great risks and uncertainties [1]. Under the limited scale of venture capital [2], will venture capitalists have a bias in choosing

green and non-green? Are green technology enterprises more attractive? The answers to these questions are of great significance to guide the development of green technology start-ups in China.

The concept of green technology was first proposed by Brawn & Wield(1994)[3]. It is also called ecological technology/sustainable development technology/ low-carbon technology. Green technology innovation combines green technology and technology innovation. In the process of developing and applying new products and processes, measures are taken to help reduce the environmental burden or achieve sustainable development goals (Rennings & Zwick, 2002) [4]. We defines green technology enterprises as green ventures aiming at sustainable development and using green technologies in their businesses or offering green products/services.

With regard to the research on venture capital and technological innovation, the literatures are from countries, industry and enterprises discussed the possible relationship between them, and the research level is rich. According to the research results, it is concluded that the relationship between venture capital and technological innovation has the following forms: the first view is that venture capital can promote technological

innovation(Chen,2017)[5]. The second view is that venture capital inhibits technological innovation(Gilbert and Newbery, 1982;Wen & Feng, 2018)[6-7]. Some scholars believe that there is no significant correlation between venture capital and technological innovation(Arvanitis & Stucki, 2014)[8].

We can see that the most scholars believe that venture capital precedes technology innovation, and the views obtained are also inconsistent; only a few scholars consider technological innovation to attract venture capital (Shao, 2011; Hirukawa & Ueda, 2011) [9-10], there is little research on the relationship between green technology and venture capital. Considering that there may be great differences in market completeness between China and developed countries, this paper discusses the positive or negative signals of green to venture capital from the Chinese situation. The research is not only significant to the relationship between green technology innovation and venture capital in theory, but also provides reference value for practice.

The innovations of this paper mainly include: (1) Different from the existing literature, this paper studies the reverse relationship between technological innovation and venture capital; (2) From the perspective of green, this paper deeply analyzes the difference of attraction between green technology enterprises and non-green technology enterprises to venture capital, and enriches the related theories of green entrepreneurship as well as venture capital in China; (3) Based on China's situation, this paper studies the relationship between green technology innovation and venture capital, providing theoretical and decision-making basis for enterprises to formulate financing policies to encourage green technology innovation.

2. THEORETICAL ANALYSIS AND RESEARCH HYPOTHESIS

Recently, a large number of literatures about venture financing and green entrepreneurship have emerged, which provides an argument for green technology enterprises to attract venture capital.

Firstly, it is an investment with potential high return. Although green technology or products are inherently high-risk, they are also accompanied by the promise of high returns [11]. Cui (2013) believes that the most basic motivation of investors' green investment behavior is to obtain potential benefits. Based on the profitability of green investment, many domestic venture capital institutions think that green is worth spending money on, and their own practical experience also proves that investing in green industry can achieve better economic benefits. Therefore, it is attractive for venture capital institutions to invest in green fields.

Secondly, green technology has a bright future. Green technology is a subversive emerging technology, which

has attracted the attention of many media and the support of the government in recent years, and a large number of policies have flocked to support the green technology innovation of enterprises. On the one hand, the media reports make the green responsibility of enterprises get more attention and recognition, and the green responsibility has a significant positive effect on the promotion of enterprise value[12]. On the other hand, many policies in China (such as preferential tax policies) support the development of green technology.

Thirdly, green reputation makes green technology enterprises more attractive. In order to maximize the possibility of enterprises entering the venture capital market, new ventures need to send effective signals to potential investment institutions[13] Green technology innovation aiming at protecting environment and improving energy efficiency can bring green reputation to enterprises, and green reputation is an important competitive advantage of enterprises[14]. Besides, the number of patents is also an important signal. The green technology innovation of enterprises is often accompanied by the application of green patents, and the patents of new ventures can enhance the value evaluation of enterprises when attracting venture capital[13].

In addition, green venture capital helps venture capital institutions to establish a good image of fulfilling their social responsibilities and get positive response from the market. Yuan(2009) pointed out that green investment achieves multiple benefits including economy, society and ecology, which is in line with the long-term value investment concept advocated by ESG Investment, and is conducive to its wide social recognition, enhancing the recognition of venture capital institutions by the public and enterprises.

Relying on these arguments, we claim that green may be a positive signal, making it easier for green technology enterprises to enter the venture capital market than other enterprises. Therefore, our first hypothesis is the following:

Hypothesis 1: Compared with non-green technology enterprises, green is a positive signal for venture capital, which increases the possibility of obtaining venture capital.

However, just like other emerging technologies or industries, this technology may be ambiguous (Santos and Eisenhardt, 2009), and "green" may also bring the opposite signal to investors and hinder their possibility of obtaining external financing.

First of all, green technology has high technical complexity. A new green technology needs to be screened by the market for a long time because of its difficulty in development, immature technology, complex and diverse technical routes and other reasons (Zhu, 2010). The complexity of technology increases the complexity of projects as well as the uncertainty of

enterprise success. Secondly, the risk of green investment is high, but the rate of return is relatively low. Gaddy B. E. et al. (2017) found that compared with the investment of software companies, the failure rate of clean technology investment is higher, and even if these clean technology investments are successful, the return is usually lower than the investment in other fields[15]. Therefore, the investment payback period of green technology innovation projects is longer than that of ordinary technology innovation projects, and the risks are greater. Thirdly, the development of green economy in China is still in the primary stage, so it is difficult to accurately evaluate the technology and development prospects of green enterprises. In addition, Zhang et al. (2018) think that China's green technology innovation focuses on basic research and technology research and development[16], and the achievement transformation and market application of green technology innovation need to be improved, which will easily lead to the risk that investors bear in investment and operation can not be guaranteed accordingly, which may affect the enthusiasm of venture capital.

Based on these arguments, we argue that compared with non-green technology enterprises, green technology enterprises have longer return period, higher technical complexity and greater risk. Therefore, for venture capital, "green" may also represent this negative signal, which is difficult to receive investors' favor. Therefore, we posit the second competitive hypothesis:

Hypothesis 2: Compared with non-green technology enterprises, green is a negative signal for venture capital, which reduces the possibility of obtaining venture capital.

3. RESEARCH DESIGN

3.1 Sample

Since China's green technology venture capital started late, the research sample of this paper is the enterprises listed on the GEM of Shenzhen Stock Exchange from 2009 to 2020. The screening of research data follows the following principles: (1) excluding financial, ST, *ST and delisted companies; (2) Eliminate the observed values with missing data. Finally, 884 observations were determined, and the sample structure is shown in Table 1 below.

The sample selection process of this paper is as follows. First of all, get the list of GEM listed companies through *Wind*, get the information of the top ten shareholders of listed companies through CSMAR database, and judge whether there is venture capital support according to the names of the top ten shareholders of listed companies. With reference to Wu(2012) definition of venture capital institutions, if the words "venture capital", "high-tech venture capital" and "high-tech investment" appear in the names of

shareholders, they can generally be regarded as VC institutions. Secondly, get the company profile or business scope in the prospectus through Juchao(www.cninfo.com.cn), and judge whether it is a green technology enterprise, according to our definition of green technology enterprise. Finally, obtain the financial data of listed companies disclosed through CSMAR database.

3.2 Variable

(1) VC is a dummy variable that equals one if the enterprise has been VC-backed.

(2) Green is a dummy variable. According to the previous definition, through manual screening, equals one if the enterprise is classified as Green.

(3) Control variables: In order to eliminate the influence of other factors, this paper selects several commonly used indicators as control variables according to the literature of scholars such as Gou & Dong(2014). For the size of the enterprise(Size), the natural logarithm of the total assets of the enterprise before the IPO is selected to represent it. Asset-liability ratio (Lev) is expressed by the ratio of total liabilities to total assets before offering shares. Ownership concentration (Hold) is expressed by the shareholding ratio of the largest shareholder of the enterprise. State-owned (Gov), considering that most of the listed companies in the GEM market in China are private enterprises, combined with Line et al. (2010), we test the influence of state-owned shares, and define that if the listed companies have state-owned background, equals one.

TABLE 1. GREEN TECHNOLOGY ENTERPRISES AND VENTURE CAPITAL BACKGROUND

	Green technology enterprise	Non-green technology enterprises
VC	252	349
Non-VC	95	188
Total	347	537

3.3 Model

We use the following probit model specification:

$$P(VC=1) = \Phi(\beta_0 + \beta_1 \text{Green} + \beta_2 \text{Size} + \beta_3 \text{Lev} + \beta_4 \text{Hold} + \beta_5 \text{Gov} + \beta_6 \text{Manufacturing} + \beta_7 \text{FoundYear} + \epsilon)$$

4. EMPIRICAL ANALYSIS

4.1 Descriptive statistic

Table 2 is descriptive statistics. The results show that the average value of VC is 0.68, which indicates that 68% of GEM listed companies in the sample have obtained

venture capital. The mean value of the key variable Green is 0.393, which indicates that most of the enterprises in

the sample are non-green technology enterprises, and only 39.3% are green technology enterprises.

TABLE 2. DESCRIPTIVE STATISTICS

Variable	Obs	Mean	Std. Dev.	Min	Max
VC	884	.68	.467	0	1
Green	884	.393	.489	0	1
Size	884	10.827	.762	9.14	16.719
Lev	884	36.804	15.798	3.8	85.1
Hold	884	34.183	12.877	6.707	89.99
Gov	884	.383	.487	0	1
Manufacturing	884	.577	.494	0	1

4.2 Correlation analysis

Table 3 lists the correlations of the main variables. It can be seen that there is a significant positive correlation between Green technology enterprises and venture

capital (VC), which shows that green technology enterprises can attract the support of venture capital more than non-green technology enterprises. Because the Person correlation coefficient analysis does not consider the influence of other control variables, it needs to be further tested with regression analysis.

TABLE 3. PEASON CORRELATION COEFFICIENT OF MAIN VARIABLES

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) VC	1.000							
(2) Green	0.080*	1.000						
(3) Size	0.185*	0.106*	1.000					
(4) Lev	-0.055	0.114*	0.321*	1.000				
(5) Hold	-0.140*	0.042	0.107*	0.077*	1.000			
(6) Gov	0.182*	0.047	0.094*	0.047	-0.002	1.000		
(7) Manufacturing	0.006	0.238*	0.159*	0.067*	0.049	0.087*	1.000	
(8) FoundYear	0.032	0.076*	0.085*	-0.007	-0.065	-0.062	-0.008	1.000

Note: p < 0.10, **p < 0.05, ***p < 0.01.

4.3 Regression results

TABLE 4. BASELINE ECONOMETRIC RESULTS

	Coef.	St.Err.	t-value	p-value	Sig
VC					
Green	.229	.098	2.34	.02	**
Size	.45	.069	6.48	0	***
Lev	-.012	.003	-3.83	0	***
Hold	-.018	.004	-4.92	0	***
Gov	.51	.098	5.21	0	***
Manufacturing	-.133	.096	-1.38	.166	
FoundYear	.002	.01	0.16	.875	
Constant	-6.658	20.089	-0.33	.74	
Pseudo R ²	0.093				

TABLE 5. MARGINAL EFFECT OF PROBIT MODEL

	dy/dx	Std.Err.	z	P>z
Green	0.074	0.031	2.360	0.018
Size	0.145	0.021	6.890	0.000
Lev	-0.004	0.001	-3.910	0.000
Hold	-0.006	0.001	-5.140	0.000
Gov	0.165	0.030	5.450	0.000
Manufacturing	-0.043	0.031	-1.390	0.165
FoundYear	0.001	0.003	0.160	0.875

Table 4 reflects the regression results after using Probit estimation. In the table 4, it can be found that the point of Green coefficient of virtual variable is estimated

to be 0.229, which is significantly positive at the level of 0.05. It indicates that green technology enterprises are more likely to obtain VC than non-green technology enterprises. Generally speaking, from the perspective of financiers, the "green" label of enterprises is conducive to increasing image, promoting enterprise performance, and bringing positive signals for venture investors to obtain high returns. From the perspective of investors, green technology has great growth potential, so green enterprises are more attractive.

With regard to the control variables, we can see the results that the variables *Size*, *Lev*, *Hold* and *Gov* are all significant at the level of 0.01, which indicates that the enterprise scale, asset-liability ratio, ownership concentration and whether the enterprise has a state-owned background will all affect the possibility of obtaining venture capital for green enterprises. Specifically, there is a positive correlation between enterprise size, state-owned property and VC at a significant level of 1%, which indicates that companies with larger enterprise scale and state-owned background are more favored by investors and easier to obtain the support of venture capital. However, the coefficient corresponding to the asset-liability ratio and the equity concentration ratio is significantly negative, indicating that the higher the asset-liability ratio and the more concentrated the equity, the possibility of obtaining venture capital is relatively low.

5. DISCUSSION AND CONCLUSIONS

In this paper, the enterprises are divided into green technology enterprises and non-green technology enterprises from the perspective of their own characteristics, and the differences in obtaining venture capital support between them are compared. The results show that green is a positive signal for enterprises to obtain venture capital. That is to say, under certain other conditions, compared with non-green technology enterprises, green technology enterprises are more likely to enter the venture capital market and obtain venture capital.

Our conclusion is inconsistent with Mrkajic et al. (2019) that born-to-be-green does not influence the likelihood to receive VC[17]. Because China's economic system are different from those of western countries, their research conclusions may not be suitable for China. Although the risks are extremely high, the huge development potential makes investors willing to take high risks in order to obtain high returns, and enjoy the benefits by replacing equity with capital (Xing, 2019)[18]. Therefore, investment in green technology is more favored by venture investors.

According to the research conclusion, the practical enlightenment is as follows:

For venture capital institutions, pay attention to new technologies, especially new technology investment opportunities with disruptive innovation. Green investment is a big direction, so we should track investment in green fields. For enterprises, it is necessary to pay attention to green technology innovation, increase investment in green technology research, which is not only beneficial to environment, but also can attract venture capital for enterprises. In addition, it is necessary to improve the quality of enterprises by expanding their scale and strength, send a strong signal to investors that they have a promising future, and improve the efficiency of financing. As for the government, the implementation of green technology innovation policy not only encourages enterprises to vigorously develop green technology, but also brings positive effects for them to obtain financial support. Therefore, the government should continue to increase policy support, guide venture capital into the field of green technology, and provide a strong guarantee for the technological innovation activities of green enterprises.

Some limitations of the present study are worth noting. Firstly, we do not explore the interaction between the industry background and VC. Green industry includes many industries, which may have different attractiveness to venture capital. In addition, due to the lack of a unified standard for the definition of green technology enterprises, we mainly divide green and non-green technology enterprises according to whether the technology used or the products sold by enterprises are green. Future research can study how they understand and recognize the signal of green and how to make green venture capital from the perspective of venture capital.

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