



Research on the influence of Venture Capital on intellectual property Pledge loan of technology based small and micro enterprises in the start-up stage

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Abstract. Under the background of the global economic decline caused by COVID-19 's epidemic situation, the contradiction between supply and demand of intellectual property pledge financing in China has become increasingly prominent. This paper introduces venture capital into the process of intellectual property pledge financing, and explores how to solve the "three difficulties" restricting the development of intellectual property pledge financing in our country from the perspective of venture capital, so as to promote the development of intellectual property pledge financing in our country. The study found that the increase in the amount of venture capital investment can promote the start-up small and micro enterprises to carry out intellectual property pledge financing activities, while the increase in the number of venture capital financing rounds is also conducive to intellectual property pledge financing.

Keywords: intellectual property pledge financing; venture capital; financing constraint.

1 Introduction

Innovation is not only the fundamental driving force for enterprises to maintain sustainable competitive advantage and even create high profits, but also an important guarantee for the country to achieve economic transformation and upgrading and high-quality development. In recent years, affected by the COVID-19 epidemic, the global economy has declined. In order to maintain their own business, technology based small and micro enterprises in the start-up stage continue to increase investment in independent research and development, bear increasing pressure on liquidity funds, and the demand for intellectual property pledge financing services continues to increase. At the same time, the state has also issued a series of notices requiring to optimize the service system, strengthen service innovation, and promote bancassurance institutions to expand the pledge of intellectual property rights. However, at the present stage, the main participants in intellectual property pledge financing in China are commercial banks, and the asset mortgage guarantee required by traditional banks' credit, in conflict with the

characteristics of small and micro scientific and technological enterprises with financing needs, such as light assets, long growth period, slow profits and so on, enterprises not only lack the necessary business flow for examination and approval, but also difficult to provide tangible assets for mortgage financing. The problems caused by information asymmetry between supply and demand, such as difficult assessment, difficult risk control, difficult disposal and high cost of obtaining customers, have seriously hindered the large-scale development of intellectual property pledge financing in our country. At the same time, in the process of actual operation, because of the problems such as information asymmetry and mismatch between supply and demand, enterprises are often faced with problems such as long application cycle and the actual amount of financing is far less than the amount of evaluation. If things go on like this, it is not only not conducive to the large-scale and sustainable development of China's intellectual property pledge financing, but also to the realization of the goal of becoming a powerful country in science and technology. Based on this, this paper holds that venture capital institutions, as a form of capital that is naturally compatible with the front end of the entrepreneurial chain, is highly professional, independent and a third party that cooperates with banks for a long time. If venture capital is introduced into intellectual property pledge financing, which is mainly participated by small and micro scientific and technological enterprises in the early stage, it will effectively alleviate many problems caused by information asymmetry and promote the development of intellectual property pledge financing in our country.

2 Literature review

Many scholars have studied the influence of venture capital on corporate financing constraints a long time ago. Lin Jianxiu (2020) believes that compared with other financial intermediaries, venture capital will make full use of its professional ability to collect information, analyze and evaluate investment opportunities before deciding to invest in an enterprise. the enterprises screened by venture capital evaluation are better than those that do not accept venture capital before they enter[1]. Supradeep Dutta (2016) believes that venture capital-supported enterprises have more influential innovation and faster commercialization [2]. Wu Chaopeng et al (2012) believe that the addition of venture capital can not only restrain the company's over-investment in free cash flow, but also increase the short-term interest-bearing debt financing and external equity financing of the company. and to some extent alleviate the problem of underinvestment caused by the shortage of cash flow. Even after listing, the supervision function, reputation resources and financing relationship network of venture capital institutions can still be used to solve the problems of agency and information asymmetry, so as to promote the standardization and rationalization of enterprise investment and financing behavior [3]. Wang Lei and Chen Mengyang (2017) believe that venture capital alleviates the financing constraints of invested enterprises by strengthening corporate social capital [4]. Hochberg (2007) believes that venture capital institutions can not only provide funds for enterprises directly, but also make use of the relationship network formed

with other external investors, on the one hand, they can strive for more financing opportunities for enterprises, on the other hand, they can also indirectly provide other facilities for enterprises through the relationship network [5]. In addition, Wu and Dong (2022) concluded that venture capital helps to promote basic innovation and commercial innovation through empirical analysis[6]. In the aspect of intellectual property, the current research is mainly focused on the legal and social level.

In the economic aspect, Wan Shaole et al. (2023) believe that intellectual property pledge financing is an important means to alleviate the lack of funds of scientific and technology small and medium enterprise. In the aspect of intellectual property pledge financing, many studies have focused on the evolution of intellectual property pledge financing model and the value evaluation of intellectual property pledge financing [7]. Zhan and Wang (2021) studied the current intellectual property pledge financing protection system and the typical model of intellectual property pledge financing [8]. Cao and Li (2021) discussed in detail the current methods for evaluating the value of intellectual property pledge financing by scholars at home and abroad. It is pointed out that most scholars believe that the value evaluation of intellectual property pledge financing should choose mortgage value or market value [9]. Wang (2022) puts forward constructive suggestions such as the establishment of authoritative evaluation institutions through the analysis of the current situation and mode of intellectual property pledge financing in China[10].

The above research results are mainly aimed at the model development and valuation model, but there is little research on the problems in the process of intellectual property pledge financing. Therefore, the contribution of this paper is mainly reflected in: studying the relationship between supply and demand of intellectual property pledge financing in China from the perspective of venture capital, focusing on the technology based small and micro enterprises in the start-up stage in the software and information technology industry in the initial stage, and put forward targeted suggestions to make up for the lack of related research.

3 Econometric models and data sources

3.1 Research hypothesis

Venture capital through its authentication role, value-added role to improve the credit and enterprise value of start-up small and micro enterprises, integrate resources, promote technology based small and micro enterprises in the start-up stage to better pledge financing of intellectual property rights, the increase in the amount of venture institutional investment directly reflects the impact of venture capital on enterprises, at the same time, experts and scholars generally believe that. The increase of the number of venture capital rounds will improve the certification role of venture capital and reduce the risks faced by bank pledge. Therefore, this paper makes two hypotheses:

Hypothesis 1: the higher the amount of venture capital, the more conducive to the intellectual property pledge financing of technology based small and micro enterprises in the start-up stage of software and information services.

Hypothesis 2: the more rounds of venture capital, the more conducive to intellectual property pledge financing for technology based small and micro enterprises in the start-up stage of software and information services.

3.2 Variable selection

1). The explained variable.

The amount of IPR pledged financing is taken as the explanatory variable, which is recorded as pled. At the same time, the data of utility model and appearance model and rejected and substance review are removed.

2). Explanatory variables.

This article assumes that both the amount of venture capital and the number of rounds have a positive impact on the development of intellectual property pledge financing, therefore setting up two explanatory variables, Risk1 and Risk2. Risk1 represents the amount of venture capital, Risk2 represents the number of investment rounds, and assigns a value of 0 to enterprises that have not received venture capital.

3). Control variables.

Rd represents the company's own research and development investment. For the science and technology small and micro enterprises in the start-up stage, the more Rd investment of the enterprise itself, the greater the potential of the enterprise, the higher the quality and exclusiveness of intellectual property pledge, and the increase of enterprise profit also reduces the risk of default of intellectual property pledge financing. In order to eliminate the influence of heteroscedasticity, the natural logarithm is taken.

Sale indicates the increase in sales revenue of the enterprise. When the enterprise sales income continues to grow, the operating condition of the enterprise is better, and the demand for intellectual property pledge financing is reduced. It is generally used to obtain the data of the patent pledge financing period for the first time, and when it is missing, it is replaced by the financial data of similar time nodes. at the same time, in order to eliminate the influence of heteroscedasticity, it is also take logarithm.

Num said that the number of intellectual property rights granted to enterprises, data excluding utility model and design patents. The more intellectual property rights an enterprise has, the more pledge financing can be carried out.

The details are shown in the following Table 1:

Table 1. main variables and definitions

Categories	Variable	Meaning	Notes
Explained Variable	Pled	Number of intellectual property pledge financing	
explanatory variable	Risk1	Venture capital amount	
	Risk2	Venture capital rounds	
control variable	Red	Enterprise R&D investment	Take logarithm

Categories	Variable	Meaning	Notes
	Sale	Growth in enterprise sales revenue	Take logarithm
	Lev	Corporate leverage ratio	Total liabilities/total assets
	Num	The number of intellectual property rights owned by enterprises	Excluding utility model and design patents

3.3 Model setting

After setting the explanatory variable and the explained variable, this paper constructs the preliminary empirical model as the following multiple regression model:

$$Pled = \beta_1 \ln risk1 + \beta_2 \ln risk2 + \beta_3 Rd + \beta_4 Sale + \beta_5 Lev + \beta_6 Num + \varepsilon_i$$

3.4 Data sources

As small and micro enterprises, especially small and medium-sized software information enterprises, participate more in intellectual property pledge financing in China, this paper first selects software and information technology service enterprises that have been established for no more than five years from 2012 to 2022 through Aiqicha software. Then use Baiteng, China intellectual property Pledge financing Network, State Administration of Taxation and other information data to cross-compare, and eliminate the lack of key information, enterprise cancellation and other data, a total of 146 enterprises meet the requirements of the sample data.

4 Empirical analysis

4.1 Descriptive statistics

Table 2. descriptive statistics

variable	N	mean	sd	min	max
Pled	146	6.1623	14.198	0.000	128
Risk1	146	3.012	11.876	0.000	119
Risk1	146	2.473	2.663	0.000	8
Rd	146	0.610	1.259	0.000	10.210
Sale	146	0.952	2.674	-0.622	23.612
Lev	146	0.383	0.665	0.000	1.577
Num	146	157.982	374.552	0.000	2433

In Table 2, we can see on average each enterprise in the sample has 6 intellectual property pledge financing items, reflecting the high-tech characteristics of the sample enterprises. The range is significant, reflecting significant differences in the level of development between enterprises. At the same time, it can be seen that although the number

of rounds of venture capital is relatively low, the intervention amount is high, which indirectly proves that venture capital institutions have a great interest in this type of enterprise, and their development characteristics meet the requirements of venture capital institutions.

4.2 Stationarity test

Table 3. stationarity test of sample data

	Pled	Risk1	Risk2	Rd	Sale	Lev	Num
t	9.767836	7.810875	7.789307	6.994031	10.559360	10.653420	9.430202
prob	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 3 shows that the ADF test of the sample shows that the p values are all less than 0.05. the original sequence is stable under this test and passes the stationarity test.

4.3 Regression results

Table 4. regression result analysis table

Variable	Coefficient	Std.Error	t-Statistic	Prob
ei	-2.349617	0.374683	-6.473406	0.0000
Risk1	3.268281	0.928086	3.489184	0.0007
Risk2	1.1322280	0.317663	3.554178	0.0005
Rd	10.159600	2.269014	4.467384	0.0000
Sale	-1.671648	0.813842	-2.039021	0.0439
Lev	0.157680	0.290133	0.543932	0.0487
Num	0.016786	0.003296	5.339645	0.0000
R-squard				0.8865
Prob(F)				0.0000

Meanwhile, Table 4 shows that the increase of enterprises' own investment (Rd) will also promote enterprise intellectual property pledge financing, because the increase of enterprises' own Rd investment will increase the quantity and quality of intellectual property owned by enterprises, and help to improve the recognition of intellectual property rights in pledge financing. For enterprises, the premise of increasing their own Rd investment is that they have enough funds. However, if the enterprise's own sales revenue growth (Sale) is larger, then the demand for intellectual property pledge financing will be lower, while the software and information service technology enterprises generally small scale, poor visibility, their own sales income growth is low. Therefore, for small and medium-sized micro enterprises of software and information service technology enterprises, intellectual property pledge financing will effectively alleviate their problems such as shortage of funds and low investment in R & D, and help enterprises to create more high-quality intellectual property rights. in order to achieve a virtuous

circle, help enterprises to achieve their own development, but also help to achieve the grand goal of China's scientific and technological power.

4.4 Granger causality test

Table 5. Granger causality test

A does not Granger Cause B		F-statistic	Prob
A	B		
Risk1	Pled	4.52119	0.0129
Risk2	Pled	4.49861	0.0327
Red	Pled	2.26276	0.0183
Sale	Pled	8.23466	0.0004
Lev	Pled	0.09191	0.9074
Num	Pled	2.12973	0.0748

From Table 5, we can see that except for the number of intellectual property rights (Num) and corporate leverage ratio (Lev), the P values of other variables are all < 0.05 . therefore, this paper holds that there is a Granger causal relationship between these variables and the amount of intellectual property pledge financing (Pled). On the other hand, the P value of the number of intellectual property rights (Num) owned by enterprises is $0.0758 > 0.05$. But it is not much different from that of 0.05. it proves that the number of intellectual property rights owned by enterprises at present has little impact on intellectual property pledge financing, which also reflects the reality. The reason for the small scale of intellectual property pledge financing in China does not lie in the small amount of intellectual property rights held by software and information technology-based small and medium-sized micro enterprises in our country, but the resource mismatch caused by information asymmetry. The P value of corporate leverage ratio (Lev) is $0.9074 > 0.05$. This means that at the confidence level of 5%, the original hypothesis can not be rejected, which proves that the level of corporate leverage will not affect intellectual property pledge financing.

The corresponding coefficients of venture capital amount (Risk1) and venture capital round (Risk2) are 4.521 and 4.499 respectively, indicating that increasing the amount of venture capital and the number of venture capital rounds will help to increase the amount of intellectual property pledge financing for small and medium-sized enterprises in the software and information services industry. Encouraging venture capital to join in the process of intellectual property pledge financing will effectively alleviate the problems of small scale and low amount of financing caused by financial frictions such as information asymmetry. It can also be verified from the side that the role of joint investment in avoiding the risk of intellectual property pledge financing will prompt investment enterprises to increase their willingness to provide external financing for small and medium-sized micro-enterprises in software and information services.

In addition, the increase in R&D investment by enterprises themselves is also beneficial for technology-based small and micro enterprises in the start-up stage to engage in intellectual property pledge financing. This is mainly due to the increase in R&D, which increases the quantity and quality of intellectual property owned by enterprises,

improves the success rate, and intellectual property pledge provides funding for R&D, promoting the circulation of funds while solving pain points in enterprise development, which is beneficial for enterprises to achieve healthy development.

4.5 Robustness test

Table 6. robustness test

variable	Coefficient	Std.Error	t-Statistic	Prob
ε_i	-3.024053	0.918261	-3.278082	0.0013
Risk1	4.114502	1.485948	2.690079	0.0066
Risk2	1.118792	0.37053	2.900922	0.0047
Rd	7.424604	2.096109	3.540831	0.0005
Sale	-1.683417	1.199563	-1.426995	0.171
Lev	0.005798	0.00259	2.207765	0.0277

In order to verify the robustness of the results, this paper not only replaces part of the data, but also removes the Lev variables which obviously show irrelevant characteristics. From Table 6, we can see that the analysis conclusions of the updated data are basically consistent with the previous text and have passed the robustness test.

5 Conclusions

This article focuses on small and micro enterprises in the software and information service industry, which were in their early stages from 2012 to 2012. Empirical analysis has found that the increase in venture capital amount and the increase in venture capital rounds have a strong promoting effect on the intellectual property pledge financing of technology-based small and micro enterprises in the start-up period. This article addresses the shortcomings of previous literature research and provides a new direction for future research. Meanwhile, in response to the issues identified in this article, the following suggestions are proposed:

1. The government should first continuously improve relevant laws and regulations, actively cooperate with financial institutions, improve the evaluation system, and clarify transaction channels and systems. Secondly, establish a small and micro enterprise information management service platform to improve the transparency of enterprise information. Proactively endorse independent intermediary institutions, encourage existing venture capital institutions to fully leverage their advantages, actively explore new mechanisms for risk compensation and benefit sharing in multi-party intellectual property pledge financing. Finally, the government should continuously improve the risk sharing mechanism for intellectual property pledge financing, establish a risk compensation fund, and build a multi-level market risk sharing mechanism with multi-party participation. 2. Banks themselves should also continuously innovate products, improve service levels, guide the intervention of venture capital in the pledge financing process, encourage venture capital institutions to leverage their own advantages, rely

on their professional experience, deeply explore the intrinsic value of intellectual property, provide a panoramic description of target customer groups, and help financial institutions accurately and effectively reach potential high-quality customers. At the same time, encourage non bank financial institutions to participate and use their own advantages to provide financial support for enterprises.

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