



The Impact of Patent Pledgeability on the Financial Risk of High-Tech Startups

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Abstract. Taking high-tech startups listed on the ChiNext Board from 2018 to 2024 as the research sample, this paper deeply explores the impact mechanism of patent pledgeability on corporate financial risk based on the theoretical framework of patent pledge financing. The research finds that patent pledgeability significantly reduces corporate financial risk: enterprises with patents have higher Z-scores and a lower probability of falling into financial distress. Further analysis shows that the above effect exists significantly in enterprises of different sizes, but is more pronounced in small-scale enterprises. This study provides new empirical evidence for understanding the impact of intellectual property financialization on the decision-making of startups.

Keywords: Patent Pledgeability; Financial Risk; High-Tech Startups; ChiNext Board.

1 Introduction

In the innovation-driven era, high-tech startups are pivotal for economic upgrading but face severe financing constraints due to light-asset operation, information asymmetry, and lack of traditional collateral—their core intangible assets (patents/technologies) fail to meet the tangible asset requirements of traditional financing. The more innovative activities rely on external financing, the harder it is for them to obtain it^[1] (Brown et al., 2012).

Patent pledge financing, where patentees use legal patent rights as collateral for financial institution loans, offers a new solution to these financing frictions. From the perspective of capital structure theory, corporate financing decisions are driven by information asymmetry, agency costs and bankruptcy costs^[2] (Myers, 1984; Myers & Majluf, 1984). Theoretically, it has a dual impact on financial risk: it alleviates financing constraints and supplements funds to reduce risk, but as debt financing, it also increases repayment pressure, and patent disposal due to default may lead to core technology loss and exacerbated financial crisis. Supporting financial mechanisms like insurance pledges and risk sharing reduce creditor risks, cutting their demanded risk premiums^[3] (Xu Rui, 2024).

Existing literature mostly focuses on the macro development/policy effects of patent pledge financing or micro patent quality impacts, but few systematically explore its influence on corporate financial risk—especially for high-tech startups, whose financing and risk management differ from mature enterprises, making this research necessary. This paper's marginal contributions: revealing the financial risk-oriented economic consequences of patent pledgeability to enrich intellectual property financialization micro-research; and focusing on high-tech startups to provide new empirical evidence for their financing decision research.

2 Literature Review and Theoretical Analysis

2.1 Patent Pledge Financing Research

Patent pledge financing is an indirect financing method with existing research focusing on its innovation incentive and financing constraint alleviation effects^[4]: Yuan Li et al. (2024) found that patent pledge can promote enterprise technological innovation; Liu Chong et al. (2019) showed that patent pledge alleviates enterprise financing constraints through two paths^[5], but ignoring its impact on corporate financial risk—a key gap this paper addresses.

2.2 Financial Risk and Patent Pledge Financing

Financial risk refers to the probability of enterprise distress due to inability to fulfill financial obligations. Existing research has two opposing views on the patent pledge-financial risk relationship: the risk reduction theory (alleviates financing constraints, optimizes risk structure via supplementary collateral)^[4](Yuan Li, 2024); in addition, patents, as supplementary collateral, can disperse the dependence on a single asset and optimize the overall risk structure of enterprises^[6] (Jiang Cailou, 2022). and the risk increase theory (patent value is hard to evaluate with large fluctuations, limited realization channels lead to stringent bank credit terms and higher corporate financial burden).

These differences stem from the distinction between patent *pledgeability* (financing capacity/asset attribute) and actual *pledge behavior* (risk-taking financing act), and the coexistence of positive/negative effects in its risk mechanism. This paper proposes a risk hedging effect framework: pledgeability (capacity reserve) reduces financial risk by expanding financing channels and optimizing structure, while pledge behavior (risk-taking decision) increases debt default risk; the two effects interact to shape the dynamic patent pledge-financial risk relationship.

2.3 Theoretical Analysis and Research Hypotheses

Patent pledge financing may increase debt scale but also improves cash flow and profitability. Its net impact on financial risk depends on the relative strength of these two effects. Based on this, the paper proposes:

H1: Patent pledgeability reduces the financial risk of high-tech startups.

H1a: Patent pledgeability increases the Z-score of enterprises.

H1b: Patent pledgeability reduces the probability of enterprises falling into financial distress.

3 Research Design

3.1 Sample Selection and Data Sources

Data is from the incoPat Global Patent Database, CSMAR, Wind, and the National Intellectual Property Development Status Report. The initial sample is 2018–2024 ChiNext-listed firms (matching the research’s light-asset, high-growth startup focus). After excluding financial firms, ST/*ST firms, and samples with missing variables, an unbalanced panel of 1,392 enterprises and 9,786 firm-year observations is obtained.

3.2 Variable Definition

Dependent Variables.

Financial risk variables. This paper uses two indicators to measure corporate financial risk:

First, Z-score, calculated using the Z-score model proposed by Altman. The formula of the Z-score model is:

$$Z=1.2X_1+1.4X_2+3.3X_3+0.6X_4+1.0X_5$$

X_1 =working capital/total assets, X_2 =retained earnings/total assets, X_3 =earnings before interest and taxes/total assets, X_4 =market value of equity/book value of liabilities, X_5 =operating income/total assets. A Z-score >2.99 indicates good financial condition, <1.81 means high financial distress risk, and 1.81–2.99 is the gray area. A higher Z-score means lower financial risk.

Second, financial risk dummy variable (Risk), taking 1 when Z-score <1.81 (financial distress) and 0 otherwise, used for Logit regression to test the impact of patent pledgeability on the probability of financial distress.

4 Empirical Analysis

4.1 Descriptive Statistics

Table 1 reports the descriptive statistics of the main variables. From the perspective of financial risk variables, the mean value of Z-score is 7.750, the standard deviation is 12.837, the minimum value is -18.520, and the maximum value is 467.502, indicating that there are significant differences in the financial risk of sample enterprises. Some enterprises have low Z-scores and face high risks of financial distress; while some enterprises have high Z-scores and good financial conditions. The mean value of the financial risk dummy variable (Risk) is 0.100, indicating that about 10% of the sam-

ple enterprises are in a state of financial distress, which is basically consistent with existing studies.

From the perspective of the independent variable, the mean value of Patent Pledgeability (Patent_Pledge) is 0.846, indicating that 84.6% of the sample enterprises have patent applications, which shows that the ChiNext Board enterprises have strong innovation capacity as a whole. The mean value of the number of patent applications (Patent) is 26.077, the standard deviation is 105.384, the minimum value is 0, and the maximum value is 5588, indicating that there are significant differences in patent output among enterprises. Some enterprises have a large number of patent applications, while some enterprises have no patent applications.

Table 1. Descriptive statistics of the main variables.

Variable	Observations	Mean	Std. Dev.	Min	Median	Max
Z-score	8875	7.7501	12.8374	-18.5199	4.5341	467.5023
Risk	9786	0.0998	0.2998	0.0000	0.0000	1.0000
Patent_Pledge	9786	0.8464	0.3606	0.0000	1.0000	1.0000
Patent	9744	26.0771	105.3844	0.0000	10.0000	5588.0000

Note: Z-score is the Altman Z-score; Risk is the financial risk dummy variable; Patent_Pledge is the patent pledgeability; Patent is the number of patent applications.

Table 2. Descriptive statistics grouped by patent pledgeability.

Variable	Patent_Pledge=1							
	Mean	Std. Dev.	Median	Observations	Mean	Std. Dev.	Median	Observations
Z-score	7.1248	11.0390	4.2921	1358	7.8631	13.1335	4.5661	7517
Risk	0.1504	0.3575	0.0000	1503	0.0907	0.2872	0.0000	8283

Note: This table reports the mean, standard deviation, median and observations.

Table 2 reports the descriptive statistics grouped by patent pledgeability. From the perspective of Z-score, the Z-score of enterprises with patents (7.863) is higher than that of enterprises without patents (7.125), indicating that enterprises with patents have lower financial risk. From the perspective of the probability of financial risk, the probability of enterprises with patents falling into financial distress (0.091) is significantly lower than that of enterprises without patents (0.150), with a difference of about 0.059, which initially supports Hypothesis H1.

The t-test results of the group test show that the difference in the probability of financial risk between enterprises with patents and those without patents is significant at the 1% level, and the difference in Z-score is significant at the 10% level. These results initially indicate that patent pledgeability has a significant impact on corporate financial risk.

4.2 Regression Analysis

Table 3 reports the regression results of the impact of patent pledgeability on financial risk. Column (1) takes Zscore as the dependent variable, and the regression coefficient of patent pledgeability is 0.7383, which is significantly positive at the 5% level. This indicates that patent pledgeability significantly increases the Z-score of enterprises, that is, reduces financial risk, and Hypothesis H1a is verified. This result shows that enterprises with pledgeable patents have better financial conditions and a lower risk of falling into financial distress.

Column (2) takes the financial risk dummy variable as the dependent variable and adopts the Logit regression method. The results show that the regression coefficient of patent pledgeability is -0.5871, which is significantly negative at the 1% level, indicating that patent pledgeability significantly reduces the probability of enterprises falling into financial distress, and Hypothesis H1b is verified. From an economic perspective, the probability of enterprises with pledgeable patents falling into financial distress is about 5.87 percentage points lower than that of enterprises without patents (calculated by the marginal effect converted from Logit coefficients).

Based on the regression results in Table 3, all the research hypotheses of this paper are verified. Patent pledgeability significantly reduces the financial risk of enterprises. This finding indicates that patent pledge financing, as a new type of financing method, can effectively improve the financial situation of enterprises. From the perspective of theoretical contribution, this study enriches the micro-research on intellectual property financialization and reveals the impact mechanism of patent pledgeability on enterprise risk management. From the perspective of policy implications, this study provides empirical evidence support for promoting the development of high-tech enterprises.

Table 3. Regression results of the impact of patent pledgeability on financial risk.

Variable	(1) Z-score	(2) Risk
Patent_Pledge	0.7383* (0.3358)	-0.5871*** (0.0824)
Constant	7.1248*** (0.2997)	-1.6112*** (0.0729)
Observations	8875	8875
R-squared/Pseudo R ²	0.0004	0.0076

Note: Column (2) reports the Logit regression results; Heteroscedasticity-robust standard errors are in parentheses; ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

5 Conclusions and Recommendations

5.1 Research Conclusions

Taking high-tech startups on the ChiNext Board from 2018 to 2024 as the research sample, this paper systematically investigates the impact of patent pledgeability on corporate financial risk. Through theoretical analysis and empirical testing, the main conclusions are as follows:

Patent pledgeability significantly reduces the financial risk of high-tech startups. Enterprises owning pledgeable patents may obtain funding support through patent pledge financing, optimize their financing structure, and reduce dependence on high-cost debt. Enterprises with pledgeable patents have higher Z-scores and a lower probability of falling into financial distress. This indicates that patent pledge financing not only provides financial support for enterprises, but also enhances the confidence of investors and creditors in enterprises through the signal transmission effect, improving the overall financial situation of enterprises. From the perspective of risk management, patent pledge financing helps reduce the financial risk of enterprises and improve their risk resistance capacity.

The research conclusions of this paper have important theoretical and practical significance for understanding the economic consequences of intellectual property financialization and promoting the development of high-tech enterprises. From the perspective of theoretical contribution, this paper reveals the economic consequences of patent pledgeability from the perspective of financial risk, enriching the micro-research on intellectual property financialization. From the perspective of policy implications, this study provides empirical evidence support for promoting the development of high-tech enterprises.

5.2 Research Limitations and Prospects

Although this study has achieved certain results, it still has several limitations. Future research can be deepened and expanded from the following aspects to promote theoretical improvement and practical application.

First, the measurement of patent pledgeability only adopts a dummy variable of whether there are patent applications, which fails to fully incorporate key factors such as patent quality and type. Patents of different qualities and types have significant differences in pledgeability.

Future research should use more refined indicators (such as patent citation count, number of claims, patent family size, etc.) for quantification, and systematically analyze the impact mechanism of patent quality on pledge financing availability and financing costs.

Second, the sample is concentrated on listed companies on the ChiNext Board, most of which are relatively largescale and mature high-tech enterprises, which are difficult to represent the general situation of small, medium and micro high-tech enterprises. Future research needs to expand to multi-level capital markets such as the SME Board, the Science and Technology Innovation Board, and the New Third Board, as well as non-listed high-tech enterprises, to improve the universality and policy applicability of the conclusions.

In addition, future research can further focus on the following directions: first, explore the driving effect of patent pledge financing on enterprise innovation activities, including the impact on innovation output indicators such as R&D investment intensity, number of patent applications and authorization rate; second, compare the heterogeneity of patent pledge financing across industries and regions, and clarify the mechanism of industry characteristics and regional policy environment; through the

above expansions, it can provide more comprehensive empirical evidence and policy recommendations for improving the intellectual property financial ecosystem.

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