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PATENT SIGNALING AND VENTURE CAPITALISTS' INVESTMENT BEHAVIORS IN CHINA

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Abstract: *In recent years, China's venture capital (VC) industry has experienced rapid growth. VC investments are widely believed to carry significant risks, primarily due to information asymmetry. As a result, VC firms continuously seek information signals to reduce these risks. This study examines the influence of patent signals on VC investment decisions in China, showing that the number of patents held by startups significantly increases the amount of VC investment they attract. VC firms tend to prioritize the quantity of patents, encouraging startups to enhance their technological capabilities. However, patents do not significantly impact the number of investing institutions, as most investments come from individual firms. While the influence of patent signals might vary across different types of investors, the study finds no evidence that patent signals affect the investment decisions of foreign or foreign-domestic joint VC firms regarding investment amounts.*

Keywords: *venture capital; technology innovation; patent signal; China*

JEL Classification: *C12; D83; E22; F21; G24; M13; O31*

1. INTRODUCTION

With rapid economic development globally, the venture capital (VC) industry has significantly expanded, attracting increasing attention from investors and investees. According to STATISTA[1], the total capital raised in the worldwide VC market is forecasted to reach $468.4 billion in 2024, up from $349.5 billion in 2023. However, global VC investment recently dropped to $75.9 billion across 7,520 deals in the first quarter of 2024 (Q1'24), down from $83.8 billion in the previous quarter, according to the KPMG Q1'24 Venture Pulse Report – Global Trends[2]. This decline was driven by

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[1] https://www.statista.com/outlook/fmo/capital-raising/traditional-capital-raising/venture-capital/worldwide

[2] https://kpmg.com/xx/en/home/campaigns/2024/04/q1-venture-pulse-report-global.html

concerns about geopolitical tensions, a lack of exits in the market, and a pullback in investment at the later deal stages. The Americas remained dominant, attracting the largest share of VC investment globally in Q1'24, followed by Asia, which saw significant investment led by major raises in China.

From a macro perspective, the VC industry positively impacts economic development in both prosperous and recessionary periods. From a micro perspective, VC involvement improves corporate governance and fosters innovation. Additionally, VC stimulates the job market, positively impacting employment in sectors such as semiconductors, biotechnology, telecommunications, AI, and computing, and increasing the demand for skilled labor. VC also effectively encourages innovation across various industries, including traditional sectors, benefiting a wide range of companies.

As the VC industry grows, academic interest has surged. While foreign research extensively covers VC decision-making, influencing factors, technological innovation performance, and signaling effects, studies in China remain limited, particularly regarding patent signals. Information asymmetry between venture capitalists and startups necessitates reliable signals to guide investment decisions. Patents, as indicators of technological innovation, are crucial in this context. This study focuses on the impact of patent signals on VC decisions in China, addressing a gap in domestic research with the theoretical foundation of VC and patent signals. It also explores the investment process, strategies, and factors influencing VC decisions, emphasizing the multifaceted role of patent signals in China's VC market.

China’s market has been influenced by events such as political tensions and competitions between China and certain Western countries since the pandemic. These events include trade wars, supply chain diversification, Huawei and 5G networks, territorial disputes over the South China Sea, and the origin of COVID-19. The volatility and complexity introduced to China’s market by non-business influences make it difficult to isolate business factors affecting VC investment decisions. Therefore, we have chosen to analyze data from a more stable period before the pandemic. This approach aims to better understand the business dynamics and their impact on VC decision-making in a more controlled environment. By doing so, we hope that our findings are not skewed by extraneous variables and provide clearer insights into how patent signals affect VC investments under typical market conditions.

Empirically, we collected data on VC investments and patents in China from January 1, 2013 to December 20, 2015 to analyze the impact of patents on VC decisions. According to 2015 data from the data terminal of ChinaVenture3, the domestic VC

[3] https://www.chinaventure.com.cn

market disclosed 2,824 deals with a total investment of $36.952 billion. This represents a significant increase from 2014, with the number of deals remaining stable but the investment amount doubling. The internet, telecommunications, and IT sectors were particularly attractive to Venture capitalists due to their rapid growth and high innovation potential. With the analysis results, our study aims to enhance the understanding of patent signals in VC decision-making and provide guidance for venture capitalists on selecting promising investments and for startups on attracting VC by enhancing their technological innovation capabilities. Our study will also offer policymakers advice on fostering innovation and investment.

2. LITERATURE REVIEW

VC investment is inherently high-risk due to technological challenges, lengthy research cycles, and complex legal environments, which heighten uncertainty and necessitate careful target selection (DiMasi & Grabowski, 2007). Start-ups, often characterized by a lack of profitability and stable organizational structures, pose additional risks, prompting venture capitalists (VCs) to adopt rigorous evaluation methods (Wilbon, 1999). Information asymmetry compounds these challenges, making it difficult for start-ups to effectively convey their potential to investors (Cumming, 2005). This issue is particularly acute in knowledge-intensive industries, where limited historical data and technological uncertainties exacerbate the knowledge gap (Haeussler et al., 2014).

To address these uncertainties, VCs rely on "signals" to aid decision-making. Spence (1973) introduced the concept of signaling as a means for companies to differentiate themselves. In this context, patents have emerged as a key signal for assessing a company's potential. Research demonstrates that patents reduce information asymmetry by signaling a company's research capabilities (Lemley, 2000; Mann & Sager, 2007; Hsu & Ziedonis, 2013). Two factors make patents effective signals: first, they undergo review and certification by independent bodies, such as patent offices, providing objective validation (Heeley et al., 2007). Second, patents confer competitive advantages by deterring rivals and enhancing a company's reputation, which attracts better external resources (Noel & Schankermann, 2013; Muller & Penin, 2006). The review of existing studies related to this topic is further organized into three areas.

2.1 The diminishing signaling power of patents

The signaling power of patents is not static and often diminishes over time. Fama (1980) linked information asymmetry to agency problems in VC-backed firms,

which Neher (1999) suggested could be mitigated through multi-round financing. Subsequent studies (Gorman & Sahlman, 1989; Gompers, 1995) found that multiple financing rounds reduce information asymmetry as VCs gain deeper insight into a company's operations. Patents play a critical role in the early financing stages but decline in importance as VCs become more involved (Higgins & Gulati, 2006; Hsu & Ziedonis, 2013).

Hoenen et al. (2014), focusing on biotechnology firms, found that patents increased funding in the first round but had less influence in later rounds, reinforcing the diminishing signaling effect. Similarly, Hsu and Ziedonis (2013) showed that patents positively influence valuation during early financing rounds. Fabrizi et al. (2013) advanced this understanding by proposing a patent-signaling model, arguing that VCs leverage patents to signal high-value companies to acquirers, boosting patenting intensity and long-term performance while inflating acquisition prices.

Other studies have linked patents to VC financing in diverse contexts. Baum and Silverman (2004) demonstrated a positive correlation between patent count and VC investment, while Cao and Hsu (2011) found that start-ups with patents received more investment and longer incubation periods. Bellucci et al. (2023) highlighted the growing importance of green patents, showing that green innovators are more likely to attract VC funding. Conversely, Guo and Jiang (2022) explored how VC characteristics influence the impact of patents on innovation, finding that VC-backed firms outperformed their non-VC-backed counterparts in patenting new product sales, and exports because of the ex-ante selection and ex-post value-added effects of VC investment. An et al. (2023) examined patents as signaling tools for IPO performance in Japan, analyzing 338 IPOs from 2000–2015 using an OLS model. They found a positive link between pre-IPO patents and cash raised, but for high-tech firms, patenting showed a negative interaction effect, reducing IPO proceeds.

2.2 Patents and VC interest

Patents not only influence the amount of funding but also the number of VC institutions interested in a start-up. Mina and Lahr (2013) found that patents primarily serve as a selection tool for attracting VC institutions, rather than guiding post-investment activities. Additionally, patent signals can reduce uncertainty and boost investor confidence. Haeussler et al. (2014) suggest that the patent application and review process influences VC decisions, with companies securing funding more quickly after applying for patents. The more patents a company holds, the faster it tends to obtain financing. Haeussler et al. (2013) found that patent applications positively influence VC financing in British and German companies. They argued that patents act

as signals for ventures and trigger institutional processes, such as generating search reports and citations, which provide valuable insights that further attract VC financing.

2.3 Insights from China

Global studies provide foundational insights into how patent signals influence VC investment decisions, but research in China highlights unique dynamics shaped by local market conditions, policies, and social connections (Guanxi). Until recently, most Chinese research focused on the effects of VC on corporate performance and innovation. For instance, Ma et al. (2005) and Zhai et al. (2010) showed VC's critical role in enhancing firm stability and growth in volatile markets, especially for early-stage companies.

On technological innovation, Chinese research has explored theoretical and empirical dimensions. Fang and Wang (2013) found that VC's impact on innovation depends on policy context, with stronger support significantly enhancing outcomes, contrasting with Western markets where VC is well-integrated into innovation systems. Empirical studies support this. Mai et al. (2012), using Kauffman Firm Survey data, compared VC and angel investments, highlighting distinct pathways for supporting entrepreneurship. Similarly, Gou and Dong (2013) found that VC's timing significantly influences innovation in Chinese SMEs, shaped by their development stages.

In examining the role of patents as signals for VC investment in China, recent studies by Xu et al. (2018) and Chen et al. (2017) demonstrated that patent activity significantly enhances the likelihood of securing VC investment in China, where Xu et al. noted that patent sensitivity is stronger in regions with robust intellectual property protections. Chen et al. (2016) found that each additional patent positively affects valuation, particularly for foreign VCs. Zheng and Zhang (2019) analyzed patents' technological, commercial, and legal signaling effects in bio-pharmaceutical start-ups, identifying factors that influence VC funding.

Recent studies provide more nuanced insights. Qi and Liu (2020) emphasized patents' signaling importance during early financing rounds. Chen et al. (2021) found that government VC agencies prioritize patent signals, particularly in state-owned or locally focused investments. Yang and Fan (2024) explored patent quantity and quality, showing that while patents attract VC interest, their effectiveness is moderated by VC reputation and geographic alignment with start-ups.

In summary, our study explores how patents influence VC investment decisions in China's evolving market, building on global and Chinese literature. By examining the relationship between patent signals and VC interest, we offer new insights into the role of intellectual property in investment strategies. The findings will highlight

practical implications: VCs can use patent portfolios to evaluate opportunities in high-growth sectors, while start-ups can leverage patents to attract investment and showcase innovation. Policymakers can apply these insights to strengthen the VC ecosystem, encourage intellectual property development, and support sustainable growth in China.

3. RESEARCH METHODOLOGY

This section outlines our research methodology and proposes four hypotheses regarding the impact of patent signals on VC decision-making. Building on the literature review of patent signals and VC investments, these hypotheses focus on the amount of financing, the number of investment institutions, the waiting time for financing, and the backgrounds of the investment institutions. This analysis involves a horizontal comparison across three dimensions: quantity, time, and institutional backgrounds.

3.1 Hypotheses

Based on the literature, we propose four hypotheses as follows.

- ***Hypothesis 1***: We argue that the number of patents held by invested companies significantly affects the amount of investment they receive from VC institutions. This is further divided into two sub-hypotheses:
  - ***Hypothesis 1-a***: Companies with patents receive more investment from VC institutions than those without patents.
  - ***Hypothesis 1-b***: The number of patents is positively correlated with the amount of investment a company receives from VC institutions; the more patents a company holds, the greater the amount of investment it will attract.
- ***Hypothesis 2***: The number of patents is positively correlated with the number of investment institutions; the more patents a company has, the greater the number of VC institutions that will invest in it.
- ***Hypothesis 3***: The more patents a startup holds, the faster it can secure financing from VC institutions.
- ***Hypothesis 4***: The impact of patent signals varies among different investment institutions, with the effect being greater for foreign institutions than for Chinese or joint Chinese-foreign institutions.

3.2 Data collection

Data collection is divided into two main parts: VC data and patent signal data. The VC data is sourced from the ChinaVenture data terminal, while the patent data is

sourced from the China National Intellectual Property Administration (CNIPA)4 patent information service platform.

The sample selection for the VC data includes all companies in China that received VC from January 1, 2013, to December 20, 2015. Then, companies were filtered using the following criteria:

- Kept companies if the financing nature is determined as Series A5, excluding those receiving Series B or higher.
- Excluded samples where the company is in the profitable phase.
- Selected companies located in China, excluding all foreign startups.

After filtering, 1,894 VC samples were selected. Subsequently, the names of the startups were used as keywords to search for each company's patent data on the CNIPA patent information service platform. The patent status is categorized into valid patents, invalid patents, and patents under examination, all of which are recorded. The total number of patents before the financing date is determined based on the financing date. Although patents may have different types (e.g., invention, design), we do not differentiate between patent types, treating all as equivalent. The author's name will use bold, 10pt characters, centered-aligned.

3.3 Data characteristics

The variables used in our data collection are summarized in Table 1. Based on the aforementioned hypotheses, the dependent (or response), independent (or explanatory), and control variables required for the testing model (outlined in Section 4) will be derived or calculated from these variables.

Table 1. *Data variables and descriptions*

Variable	Description
INV	Amount of financing received by the invested company
LNINV	Natural logarithm of INV
PATENT	Number of patents before receiving VC
PDUMMY	Dummy variable indicating whether the company had any patents before receiving VC (1 = yes, 0 = no)
AGE	Years since the invested company's establishment
LNAGE	Natural logarithm of AGE

[4] https://www.cnipa.gov.cn/col/col1510/index.html

[5] The startup company in Series A is basically on track and has a complete business and profit model, holding a certain position and reputation within the industry. However, it is still operating at a loss. At this stage, funding comes from professional venture capitalists, with investment amounts typically ranging from 10 million to 100 million RMB. The company's valuation has an estimated value of exceeding 100 million RMB.

Variable	Description
VCCOUNT	Number of investing institutions
PLACE	Dummy variable indicating the company's location (1=Beijing, Shanghai, or Guangzhou; 0=other locations)
INDUSTRY	Dummy variable indicating the industry of the company (1=information transmission, computer services, and software; 0=other industries)
DURATION	Waiting time for financing, calculated as the financing date minus the company's establishment date
LND	Natural logarithm of DURATION
S1	Dummy variable for the company's development stage (1=early stage, 0=others)
S2	Dummy variable for the company's development stage (1=growth stage, 0=others)
Y3	Dummy variable for the year 2013
Y4	Dummy variable for the year 2014

For Hypotheses 1-a and 1-b (the impact of patents on funding amount) and Hypothesis 4 (comparing the responses of investment institutions with different backgrounds to patent signals), the dependent variable is the natural logarithm of the funding amount (LNINV), as these hypotheses explore how patents influence the amount of funding. For Hypothesis 2 (the impact of patents on the number of investment institutions), the dependent variable is the number of investment institutions (VCCOUNT). For Hypothesis 3 (the impact of patents on the speed of financing), the dependent variable is the natural logarithm of the waiting time for financing (LND), calculated from the company's establishment date to the financing date.

In line with previous research, patents are typically used as explanatory variables, often including factors like the number of patents or the nature of patent-related news (positive or negative). However, due to limitations in China's domestic databases, patent application data is not readily available. Thus, in our study, we use the total number of patents before funding (PATENT) as the independent variable for all hypotheses except Hypothesis 1-b. There are two main reasons for this choice:

- The signals available to venture capitalists at the time of decision-making are based on patent information prior to the funding date, as only publicly available data can influence investment decisions.
- The total number of patents before funding includes valid, invalid, and pending patents. Although invalid patents have lost legal protection (e.g., due to expiration or voluntary abandonment), they can still be used for product development, similar to how patent applications are treated in previous studies. Therefore, we include all patents when calculating the total number before funding.

For Hypothesis 1-b, the independent variable is the dummy variable PDUMMY, which indicates whether the company held any patents prior to receiving VC funding.

Additionally, we include multiple control variables to account for the characteristics of the startup companies and the VC firms. These control variables–company age (AGE), location (PLACE), industry (INDUSTRY), development stage (S1 & S2), and investment timing (Y3 & Y4)–are critical for the testing model. AGE reflects the number of years since the company's establishment, which is determined by verifying the founding date through online searches. PLACE is used to address the influence of a company's location on VC investment, as economic conditions and the investment climate are generally more favorable in Beijing, Shanghai, and Guangzhou. These locations are coded as 1, while other regions are coded as 0. Since different industries have varying levels of research and development (R&D) intensity, patent activity, and VC preferences, we distinguish between companies in the information transmission, computer services, and software industries (coded as 1) and other industries (coded as 0), under the variable INDUSTRY.

Moreover, we control for the development stages of the companies using two dummy variables, S1 and S2, to account for differences between early-stage and growth-stage companies, respectively. Given that our sample spans from 2013 to 2015, we also include the dummy variables Y3 and Y4 to control for the timing of investments during the observation period. These control variables help to isolate the effects of patent signals while accounting for the diverse characteristics of the companies and the investment environment.

4. EMPIRICAL ANALYSIS AND RESULTS

Three testing methods are employed in this study: descriptive statistical analysis and multiple linear regression analysis. Descriptive analysis involves examining the statistical results of various variables to analyze the characteristics of the sample. Multiple linear regression constructs regression models based on hypotheses to derive conclusions from the coefficients of the variables and the regression results.

4.1 Descriptive analysis for variables

Table 2 presents the descriptive statistics of variables in the study:

Table 2. *Descriptive statistics*

	Mean	**Median**	**Maximum**	**Minimum**	**Std. Dev.**	**Skewness**	**Kurtosis**
INV	6.705988	1.94	1000	0.01	29.06477	23.69634	744.4168
LNINV	0.75972	0.662688	6.907755	-4.605170	1.437012	-0.031140	3.621940
PATENT	4.041645	0	1000	0	30.81279	24.35279	710.5866
PDUMMY	0.215945	0	1	0	0.411585	1.380662	2.906228
AGE	5.307696	3	46	1	5.138128	2.628134	14.46011

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
LNAGE	1.317288	1.098612	3.828641	0	0.820891	0.309414	2.428011
VCCOUNT	1.214022	1	12	1	0.614139	5.521483	62.90753
PLACE	0.526927	1	1	0	0.499406	-0.107865	1.011635
INDUSTRY	0.491024	0	1	0	0.500051	0.035909	1.001289
DURATION	4.481521	2	45	0	4.937585	2.801645	15.80407
LND	1.064709	0.693147	3.806662	0	0.902721	0.473657	2.236330
S1	0.466737	0	1	0	0.499024	0.133347	1.017781
S2	0.499472	0	1	0	0.500132	0.002112	1.000004
Y3	0.226147	0	1	0	0.418445	1.309254	2.714146
Y4	0.363205	0	1	0	0.481050	0.568885	1.323630

The average financing amount among all samples is $6.706 million, with the highest financing amount reaching $1 billion. The average age of the companies is 5.3 years, with the longest being 46 years. The average number of investment institutions is 1.2, indicating that in most cases in the Chinese investment market, a single VC institution invests in one project. In terms of company locations, companies based in Beijing, Shanghai, and Guangzhou account for 52.7% of the samples, indicating that these three cities dominate half of the investment market. Regarding industry distribution, the sectors of information transmission, computer services, and software account for a large proportion, making up 49.1%. The average waiting time for financing in the sample is 4.5 years, meaning that on average, startups must wait 4.5 years after establishment to receive VC.

4.2 Testing Hypotheses 1-a and 1-b

The following regression models are used to test Hypotheses 1-a and 1-b respectively, and the results are summarized in Table 3.

$$\mathrm{LNINV} = \beta_1 \mathrm{PATENT} + \beta_2 \mathrm{VCCOUNT} + \beta_3 \mathrm{LNAGE} + \beta_4 \mathrm{Y3} + \beta_5 \mathrm{Y4} + \beta_6 \mathrm{INDUSTRY} + \beta_7 \mathrm{S1} + \beta_8 \mathrm{S2} + \beta_0 \quad (1)$$

$$\mathrm{LNINV} = \beta_1 \mathrm{PDUMMY} + \beta_2 \mathrm{VCCOUNT} + \beta_3 \mathrm{LNAGE} + \beta_4 \mathrm{Y3} + \beta_5 \mathrm{Y4} + \beta_6 \mathrm{INDUSTRY} + \beta_7 \mathrm{S1} + \beta_8 \mathrm{S} + \beta_0 \quad (2)$$

Table 3. *Regression results for the impact of patents on financing amount*

Explanatory variable	LNINV	
	Hypothesis 1-a	Hypothesis 1-b
PATENT	0.002255**	--
	(0.0263)	
PDUMMY	--	-0.00163
		(0.9849)
VCCOUNT	0.413643***	0.412459***
	(0.0000)	(0.0000)

Explanatory variable	LNINV	
	Hypothesis 1-a	**Hypothesis 1-b**
LNAGE	0.247865***	0.256256***
	(0.0000)	(0.0000)
Y3	-0.663520***	-0.66472***
	(0.0000)	(0.0000)
Y4	-0.504968***	-0.5079***
	(0.00000)	(0.0000)
INDUSTRY	-0.347653***	-0.35126***
	(0.000)	(0.0000)
S1	0.225324***	0.224896***
	(0.0095)	(0.0098)
S2	0.645880***	0.651968***
	(0.0000)	(0.0000)
R-squared	0.127906	0.125619
Adj. R-squared	0.124669	0.122374

Note: In parentheses are the p-values for the coefficients. ***, ** and * denote significance at the 1%, 5%, and 10% levels, respectively.

The results indicate that the regression coefficient for the PATENT variable is 0.002255, which is positive and significant at the 5% significance level. This suggests that Hypothesis 1-a is valid; controlling for the number of institutions and company background, each additional patent before VC funding is associated with an approximate 0.23% increase in the financing amount. Therefore, the number of patents positively influences the financing amount, indicating that the stronger the patent signal, the greater the amount of VC investment. On the contrary, the regression coefficient for the PDUMMY variable is not significant, meaning that the presence of a patent does not affect the financing amount.

Comparing the results of the above two tests, it appears that VC companies pay more attention to the number of patents rather than the presence of patents. Therefore, the invested companies should not only apply for patents but also improve their technological capabilities to obtain more patent rights, thereby effectively attracting VC companies and increasing the financing amount.

4.3 Testing Hypotheses 2 and 3

The following regression models are used to test Hypothesis 2 and Hypothesis 3. The results are shown in Table 4.

$$\begin{aligned}\mathrm{VCCOUNT} = {} & \beta_1 \mathrm{PATENT} + \beta_2 \mathrm{LNAGE} + \beta_3 \mathrm{Y3} + \beta_4 \mathrm{Y4} + \beta_5 \mathrm{S1} + \beta_6 \mathrm{S2} \\ & + \beta_7 \mathrm{PLACE} + \beta_8 \mathrm{INDUSTRY} + \beta_0\end{aligned} \tag{3}$$

$$\mathrm{LND} = \beta_1 \mathrm{PATENT} + \beta_2 \mathrm{LNAGE} + \beta_3 \mathrm{Y3} + \beta_4 \mathrm{Y4} + \beta_5 \mathrm{S1} + \beta_6 \mathrm{S2} + \beta_7 \mathrm{PLACE} + \beta_8 \mathrm{INDUSTRY} + \beta_0 \quad (4)$$

Table 4. *Regression results for the impact of patents on the number of investment institutions*

Explanatory variable	**VCCOUNT**	**LND**
PATENT	-0.000180	0.001780***
	(0.7104)	(0.0029)
LNAGE	0.180974***	0.221115***
	(0.0000)	(0.0000)
Y3	-0.105017**	0.268074***
	(0.0157)	(0.0000)
Y4	-0.051819	0.119722***
	(0.1443)	(0.0041)
S1	0.968894***	0.200649***
	(0.0000)	(0.0001)
S2	0.863551***	1.173341***
	(0.0000)	(0.0000)
PLACE	0.116420***	-0.12543***
	(0.0001)	(0.0009)
INDUSTRY	0.093574***	0.00178***
	(0.0027)	(0.0029)
R-squared	-0.091263	0.228722
Adj. R-squared	-0.095313	0.226265

Note: In parentheses are the p-values for the coefficients. ***, ** and * denote significance at the 1%, 5%, and 10% levels, respectively.

When using VCCOUNT as the dependent variable, the coefficient for the PATENT variable is negative but not significant. This suggests that patent signals do not have a significant influence on the number of investment institutions that invest in the company. We argue that in China's investment environment, most projects are funded by a single VC institution. Therefore, if startups aim to attract multiple investors, simply increasing the number of patents may not be an effective strategy. Startups likely need to pursue other approaches or business strategies to secure investment from multiple companies. Additionally, we observed that the R^2 value for this regression is negative, indicating that this model may not be well-suited for explaining the variation in the number of investment institutions using PATENT and other control variables.

In contrast, when LND is the dependent variable, the coefficient for PATENT is positive and significant (at the 1% level), suggesting that the more patents a company has, the longer the financing waiting time. However, this empirical finding does not support Hypothesis 3 and contradicts our initial expectations. This discrepancy may arise from the method used to calculate the financing waiting time. We collected data on the dates of financing and company establishment, calculating the financing waiting

time (DURATION) by subtracting the establishment date from the financing date. This approach assumes that companies apply for financing immediately after establishment, as data on the actual dates of financing applications are not available. In reality, many companies seek financing several years later due to strategic considerations, and some are founded only after receiving initial funding. Furthermore, when a company holds patents, VC institutions may require additional time to study and verify them, which extends the waiting period before the company secures financing. These factors may explain the unexpected result for Hypothesis 3.

4.4 Testing Hypothesis 4

Hypothesis 4 states that the effect of patent signals varies across different types of investment institutions in terms of their investment amount. We argue that patent signals have a greater impact on foreign investment than on Chinese (i.e., domestic) or joint (domestic and foreign) ventures. We categorized the samples into three groups based on domestic, foreign, and joint venture backgrounds. A regression model used for testing Hypotheses 1-a and 1-b was then applied, and the results are summarized in Table 5.

Table 5. *Regression results of LNINV on PATENT in three separate data samples*

Variable	**LNINV**		
	Domestic VC investment	**Foreign VC investment**	**Joint VC investment**
PATENT	0.003101*	0.016720	0.001816
	(0.0571)	(0.1470)	(0.1043)
VCCOUNT	0.435795***	0.716662***	0.542273***
	(0.0000)	(0.0001)	(0.0000)
LNAGE	0.209682***	0.148349	0.389897***
	(0.0002)	(0.5803)	(0.0000)
Y3	-0.737395***	-0.956165**	-0.687364***
	(0.0000)	(0.0216)	(0.0000)
Y4	-0.430072***	-0.943627***	-0.685842***
	(0.0000)	(0.0073)	(0.0000)
INDUSTRY	0.028716	0.779211*	0.374380**
	(0.7858)	(0.0723)	(0.0267)
S1	0.530249***	1.424164***	0.467211**
	(0.0000)	(0.0039)	(0.0107)
S2	-0.381075***	-0.445214	-0.319131***
	(0.0000)	(0.1241)	(0.0048)
R-squared	0.163846	0.244854	0.203854
Adj. R-squared	0.158491	0.193030	0.192315

Note: In parentheses are the p-values for the coefficients. ***, ** and * denote significance at the 1%, 5%, and 10% levels, respectively.

The regression results indicate that the impact of patent quantity differs across the three types of investment institutions. Specifically, each additional patent increases the investment amount by 0.31% for domestic institutions, 1.69% for foreign institutions, and 0.18% for joint ventures (based on the increase in the natural logarithm of the investment amount from the coefficient). This suggests that the influence of patent signals is strongest for foreign VC institutions, followed by domestic and joint venture institutions. Intuitively, it is expected that foreign investment institutions, having less information about domestic startups, would find patent signals more impactful. In contrast, domestic and joint venture institutions, being more familiar with the local investment environment and information, may rely less on patent signals. However, our results show that for both the foreign VC and joint VC samples, the coefficients for PATENT are not statistically significant. Therefore, Hypothesis 4 cannot be confirmed.

4.5 Summative discussions

To explore the effects of patent holdings on startup financing, several key areas were focused in our study: financing amount, number of investment institutions, and financing waiting time. The content of hypotheses and empirical results are summarized in Table 6.

Table 6. *Summary of hypothesis testing results*

Hypothesis	**Conclusion**
Hypothesis 1-a: The more patents a company has, the higher the financing amount.	Supported
Hypothesis 1-b: Companies with patents receive more financing than those without.	Not supported
Hypothesis 2: The more patents a company has, the more investment institutions it attracts.	Not supported
Hypothesis 3: The more patents a company has, the faster it can obtain VC.	Not supported
Hypothesis 4: The effect of patent signals is greater on foreign investors than on domestic or joint ventures.	Not Supported

Regarding the impact of patents on financing amounts, the regression analysis indicates that the number of patents held by startups significantly affects the amount of financing they receive. Patents act as a positive signal that enhances investor confidence and reduces information asymmetry, prompting VC institutions to invest larger amounts in companies with a higher number of patents. Interestingly, it is not just the presence or absence of patents that matters, but the quantity, as VC firms tend to focus more on the number of patents when making investment decisions.

As for the impact of patents on the number of investment institutions, the findings suggest that in the Chinese investment environment, this impact is not significant. Startups typically have specific targets and strategies for attracting VC, and an increase in the number of patents does not necessarily lead to attracting more investors.

Regarding the impact of patents on financing waiting time, the analysis highlights data limitations in accurately capturing the financing waiting period, which is defined as the time between applying for and receiving financing. Additionally, VC firms may need time to vet the background of a startup's patent holdings before offering financing, which can extend, rather than shorten, the waiting period. These factors may explain why the model results do not align with the initial hypothesis. Future research should aim to collect more accurate data on financing waiting time to better understand the relationship between patent holdings and the speed of obtaining VC.

Lastly, concerning the influence of patent signals on different types of investment institutions, it was initially expected that patent signals would have varying impacts across different types of investors, with the strongest effect on foreign investors, followed by domestic or joint venture VC investors. This variation was attributed to differences in information accessibility: foreign investors often face greater information asymmetry when investing in domestic startups compared to domestic and joint venture institutions, which have better knowledge of the local investment environment and targets, making them less reliant on patent signals. However, our results indicate that patent signals do not significantly influence the VC amount decisions of foreign or joint venture institutions.

5. PRACTICAL IMPLICATIONS FOR ASIAN BUSINESS

China's pre-pandemic analysis of patent signaling in its venture capital market provides crucial lessons for Asian businesses navigating information asymmetry and innovation-driven growth. The study's empirical findings, particularly its hypothesis tests, reveal actionable strategies for startups, investors, and policymakers across the region:

For startups: Prioritize volume from substance

Hypothesis 1-a's validation (more patents correlate with larger funding rounds) is a key takeaway. In China's dominant tech sectors (internet/IT/telecom), patent quantity effectively signaled technological capability. Asian startups must therefore prioritize systematic patent accumulation tightly linked to genuine R&D programs, moving beyond treating IP as mere compliance. However, Hypothesis 1-b's rejection (merely possessing patents does not guarantee a

funding advantage) is a critical warning. Token filings are ineffective. Patents must stem from substantive innovation to be credible signals.

While patents didn't attract more investors (Hypothesis 2 rejected) or accelerate funding speed (Hypothesis 3 rejected), they secured deeper financial commitments from lead investors. Founders should focus on attracting specialized VCs who value technological depth over broad, shallow syndicates.

For VC: Decode signals locally

VCs can leverage patent quantity (Hypothesis 1-a supported) as a cost-effective initial screening tool, especially in high-information-asymmetry markets like Southeast Asia or India. Hypothesis 4's rejection (foreign investors did not rely more heavily on patents than local investors) is pivotal. Patents alone cannot substitute for deep local market knowledge. International VCs must either partner with local firms or build in-house expertise to accurately contextualize patents – their value is heavily dependent on local regulations, competitive landscapes, and enforcement realities.

China's trend towards single-lead investors demonstrates that strong signals enable concentrated, high-conviction bets. VCs need robust frameworks to assess not just patent volume, but also quality (strength, market fit, freedom-to-operate).

For policymakers: Build credible intellectual property (IP) systems

The reliance on patent volume as a signal underscores the fundamental need for credible and trustworthy IP systems. Policymakers must actively ensure transparency (e.g., via real-time national patent databases as advised by the study) and reliability through rigorous examination processes and enforceable rights.

To attract VC investment (per Hypothesis 1-a), governments should explicitly link R&D incentives to tangible patent outputs, strengthen university technology transfer mechanisms, and offer subsidized IP services for SMEs (small and medium-sized enterprises). In addition, regional harmonization should be examined as regional cooperation (e.g., ASEAN patent data sharing and examination harmonization) is essential to reduce cross-border frictions and enhance the utility of patents as regional signals.

In summary, China's VC analysis confirms that patent quantity (Hypothesis 1-a) unlocks larger funding by mitigating information asymmetry, while mere patent possession (Hypothesis 1-b rejected) offers no inherent advantage. Patents neither attract more investors (Hypothesis 2 rejected) nor accelerate funding speed (Hypothesis 3 rejected), and foreign VCs show no heightened reliance on them

versus local knowledge (Hypothesis 4 rejected). For Asia's burgeoning innovation economies, this demands:

- Startups prioritize generating significant patent volume stemming from genuine R&D.
- VCs balance quantitative patent metrics with deep local insight and quality assessment.
- Policymakers fortify IP systems to ensure patent signals are transparent, reliable, and regionally compatible.

Effectively harnessing these insights allows patent signals to function as powerful catalysts for resilient, innovation-driven growth across the diverse Asian landscape.

6. CONCLUDING REMARKS

In this study, we investigate the impact of patent signals on VC investment behaviors in China between January 1, 2013, and December 20, 2015. We proposed and empirically tested four hypotheses. Our results indicate:

- The number of patents positively influences the amount of financing. The more patents a startup holds, the more investment it can attract from the VC institutions. We argue that a greater number of high-quality patents leads to higher valuations by VC firms, who view them as indicators of strong innovation capabilities and future potential returns, thereby increasing the financing amount a startup can secure.
- VC institutions pay more attention to the number of patents rather than whether a company simply has patents or not. Startups should not only acquire patents but also enhance their technological capabilities to increase their patent portfolio.
- Patent signals do not significantly influence the number of VC firms involved in financing. In China's investment environment, most projects receive investment from a single VC firm.
- For startups, patents do not significantly impact the waiting time to secure VC financing. However, we argue that this might be due to data limitations for our calculation of accurate waiting time, where the data of the start times of startups' financing applications was not available.
- About the influence of patent signals on different Investment Institutions, we found that the impact of patent signals varies across different types of investment institutions, but the results are not statistically significant. Patent signals'

associations with different VC investment decisions, beyond the VC amount used in our study, can be explored in future research.

Our research contributes to the literature by systematically analyzing the relationship between patents and VC investment behavior in China. From a governmental perspective, to foster a robust investment environment and promote a thriving VC market, it is advisable to increase market transparency and openness, including the establishment of comprehensive patent information platforms. Such platforms should provide rich, timely, and broad coverage, regularly updated to reflect companies' patent statuses. This would offer VC institutions a reliable source of information, enabling them to make informed investment decisions. Moreover, such a platform could encourage companies to seek patent recognition, highlighting their research and development efforts and fostering innovation. Startups could also use this information to understand market trends and innovate accordingly.

For VC firms, patents serve as a critical tool for reducing information asymmetry. The patent information of startups reflects their research capabilities and signals their future potential, thereby reducing investment risk and increasing potential financial returns. Additionally, investing in patent-holding startups offers VC firms the opportunity to learn new technologies, with the assurance that these innovations are recognized by patent offices, potentially yielding strategic benefits.

For startups, the research findings indicate that patents have a positive impact on financing. While patent signals do not notably affect the number of investment institutions or the financing waiting time, they play a crucial role in reducing uncertainty and increasing investor confidence. Consequently, startups with more patents are likely to secure more substantial VC investments. Also, companies should leverage their technological innovations to develop and apply for patents early on. While the cost of obtaining patents is significant, patents can substantiate the company's value and secure more substantial financial support.

Our research has the following limitations. First, we purposely chose the data sample that ends before the COVID pandemic to avoid the influence of unknown and non-business factors during the pandemic period. Due to time and resource constraints, the study's sample period covers three years and includes 1,894 samples, which may limit our analysis implications. Our future research could extend the timeframe and include more samples for greater generalizability and accuracy. Additionally, the selected projects in our samples have only undergone their first round of financing. Extending the study period could provide data on second or subsequent rounds of financing, allowing for a more dynamic analysis of the impact of patent signals. Specifically, it would enable comparisons between companies with and without patents,

assessing whether companies with patents achieve higher valuations or secure more substantial second-round financing. In addition, the study acknowledges the potential inaccuracy in calculating financing waiting times due to assumptions made. Future research should seek more precise data from other sources to improve this calculation.

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