

# The Impact of Fintech on Financing Constraints of Technology SMEs

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**Abstract:** The advent of financial technology (FinTech) has prompted considerable interest in its potential to enhance the financial landscape for science and technology small and medium-sized enterprises (SMEs). This paper examines the role of FinTech development in the financing constraints of science and technology SMEs, with a particular focus on the mediating mechanism of information asymmetry. The research objects are the strategic emerging industry enterprises of the Science and Technology Innovation Board. The FinTech index is constructed by logistic regression, and the double fixed effect model is used for analysis. The findings of this study indicate that the advancement of FinTech has notably alleviated the financial constraints faced by science and technology SMEs. Further examination revealed that FinTech has effectively served as an intermediary by reducing the extent of information asymmetry, thereby mitigating the financing challenges faced by these enterprises. This study offers a novel perspective and empirical foundation for understanding the role of FinTech in promoting the growth of science and technology SMEs, and it also provides valuable insights for the development of relevant policies and financial innovation practices.

**Keywords:** FinTech, Technology SMEs, Financing constraints, Information asymmetry.

## 1. Introduction

As a platform dedicated to the advancement of strategic emerging industries, the Science and Technology Innovation Board is primarily engaged in the nurturing of high-tech industries and strategic emerging industries, which mirror the latest developments in scientific and technological evolution and industrial transformation. The companies listed on the Science and Technology Innovation Board utilize innovation as a primary driving force, relying on their core technologies to facilitate production and operations. These entities play a pivotal role in addressing the country's significant strategic needs and in the development of a modern industrial system. On January 12, 2024, the State Financial Supervision and Administration Bureau published the "Notice on Strengthening Financial Services for Technology-based Enterprises Throughout Their Life Cycle." The "Notice" explicitly indicates the necessity of robustly developing science and technology finance, promoting the banking and insurance industries to further reinforce financial services for technology-based enterprises throughout their life cycle, and supporting the growth and development of technology-based enterprises. By the conclusion of 2021, technology-based enterprises had generated over 50% of China's tax revenue and were responsible for over 60% of the gross national product, fixed asset investment, and outbound investment. Nevertheless, China's science and technology SMEs exhibit considerable deficiencies in the accumulation of endogenous funds and have demonstrated certain weaknesses in the utilization of external financing channels. This dual disadvantage has resulted in significant constraints on their fundraising process, which undoubtedly impacts their development [1]. State investment and bank credit represent the primary sources of external financing for enterprises. However, there is a significant information asymmetry between technology SMEs and investors, which makes accurate assessments challenging, thus affecting bank credit

[2]. The accelerated evolution of FinTech has yielded novel avenues and strategies for the funding of technology-focused small and medium-sized enterprises (SMEs). FinTech is the application of advanced technologies, including artificial intelligence, blockchain, big data, and cloud computing, to the innovative transformation of financial products, processes, and models. As FinTech continues to evolve, numerous scholars have posited that it can diminish the disparity in information between banks and enterprises, enhance the efficacy of credit resource allocation, reduce corporate financing costs and leverage, and optimize corporate earnings management and internal control, thereby alleviating corporate financing constraints [3, 4]. Other scholars have analyzed the impact of FinTech on the financing of technology companies across different stages of the corporate life cycle [5]. They have also examined how FinTech can facilitate the growth of technology companies [6]. The contributions of this paper are as follows: (1) In comparison to research conducted on ordinary technology SMEs, the companies included in the strategic emerging industries category of the Science and Technology Innovation Board (STIB) are more widely recognized by the market, and the results of the research are more informative. (2) A logistic regression model is employed to construct a financing constraint index for technology SMEs, thereby offering a novel approach to measuring the financing constraints of such companies. (3) Prior research has conducted a substantial amount of mechanism analysis and empirical analysis on the ways in which FinTech can alleviate general corporate financing problems. However, there has been a dearth of empirical research on how the development of FinTech affects the financing constraints of such companies. This issue provides novel insights for technology SMEs to alleviate financing constraints and facilitate enterprise development.

This paper takes the strategic emerging industry enterprises of the Science and Technology Innovation Board as its research object. It studies the impact of FinTech development

on the financing of technology-based SMEs and the mediating effect of information asymmetry through empirical analysis. The relevant data from 2016 to 2020 are selected as the empirical sample data, and the mechanism path of the impact of FinTech development on the financing of technology-based SMEs is further explored.

## 2. Literature Review and Theoretical Hypothesis

Information asymmetry represents a significant factor contributing to the constraints observed in corporate financing. For small and medium-sized technology companies, when investors obtain sufficient information, it will increase the uncertainty of the company's future development, thereby leading to corporate financing constraints. A substantial body of scholarship has been devoted to investigating the influence of information asymmetry on corporate financing constraints. Stewart, M., & Nicholas, M. advanced the proposition that when the capital market is imperfect, firms do require external financing. As a consequence of information asymmetry, external investors may be unable to accurately assess the value of the company, which in turn restricts corporate financing [7]. Fazzari, S. et al. proposed the financing constraint hypothesis based on information asymmetry theory, thereby initiating the study of the relationship between investment and cash flow sensitivity of companies under financing constraints [8]. Stiglitz, J. E., & Weiss, A. demonstrated that due to incomplete information, banks are unable to accurately distinguish the risk level of borrowers [9]. Consequently, even if loan applicants are willing to pay a higher interest rate, they may not be able to obtain loans due to information asymmetry. LU Politburo has highlighted the lack of a comprehensive credit reporting system database in banks, which is further compounded by the opaque information surrounding small and micro enterprises [10]. This makes it challenging for banks to accurately assess the credit status and risks associated with these enterprises, ultimately limiting the precision of risk management and pricing. The cost of external financing is influenced by information asymmetry, and this cost differential reflects the extent of financing constraints faced by companies. Zhang Weiyang put forth the proposition that the adverse selection and moral hazard issues resulting from information asymmetry exert a considerable influence on the financing costs, financing structure, and financing strategies of enterprises [11]. In particular, the opacity of information and the inability of small and medium-sized technology companies to provide sufficient guarantees or collateral render it challenging for formal financial institutions to respond effectively to adverse selection problems and default risks caused by information asymmetry, thereby exacerbating the financing constraints of small and medium-sized technology companies [12].

In light of the aforementioned evidence, this paper puts forth the following hypothesis:

Information asymmetry serves to exacerbate the financing constraints of technology SMEs. (H1)

FinTech effectively addresses the issue of information asymmetry by facilitating the dissemination of more data and information sharing platforms. The advancement of FinTech diminishes the extent of information asymmetry between the supply and demand sides of funds, thereby markedly alleviating the financing constraints of enterprises [13].

Among these, Internet finance introduces novel financing forms, facilitates more efficient and rapid financing channels for small and medium-sized technology enterprises, reduces the degree of information asymmetry, and enhances the efficiency of capital allocation [14]. Furthermore, FinTech provides information processing and information collection technology to assist banks and other financial institutions in more accurately assessing the credit status of enterprises, thereby reducing the degree of information asymmetry in the credit market [15]. Furthermore, the integration of technology and finance has the potential to mitigate information asymmetry between borrowers and lenders, facilitate the allocation of credit resources towards small and medium-sized technology enterprises, and alleviate corporate financing constraints [16]. The advent of FinTech has introduced information processing and collection technology, cloud financing models, and information platform and certification effects, which collectively contribute to the establishment of a more symmetric information environment between investors and enterprises. This, in turn, has the capacity to effectively alleviate the financing constraints faced by small and medium-sized technology enterprises.

In light of the aforementioned evidence, this paper puts forth the second hypothesis:

That FinTech can mitigate the financing constraints faced by technology SMEs by reducing information asymmetry (H2).

The study empirically proves Hypotheses 1 and 2 by constructing a financing constraint model of FinTech and technology SMEs and the mediating mechanism of information asymmetry.

## 3. Research Design

### 3.1. Sample Selection and Data Sources

This study focuses on science and technology small and medium-sized enterprises (SMEs) as the subject of investigation. To this end, it selects qualified enterprises in the strategic emerging industries of the Science and Technology Innovation Board as the research sample. In addition, it selects the corresponding range of Peking University Digital HP Financial Index as the core explanatory variable. This is based on the time range of the explained variable, namely the Science and Technology Innovation Board Strategic Emerging Industries Enterprise Data, which spans from 2016 to 2020. The financial data for the sampled companies were obtained from the WIND database. To ensure the reliability of the data, samples with missing main variables within the specified interval were excluded, outliers were processed, and the data were standardized. Ultimately, 905 enterprises met the requisite standards.

### 3.2. Variable Selection

#### 3.2.1. Explained variable

The extent to which science and technology SMEs are constrained by financing issues. The majority of domestic and foreign scholars employ one of three methods to assess enterprise financing constraints. 1. The model regression method is as follows: Fazzari et al. put forth an investment-cash flow model for gauging enterprise financing constraints with coefficient sensitivity [8]. 2. The index method is a further approach to measuring enterprise financing constraints. Kaplan, S. N., & Zingales, L., Whited, T. M., & Wu, G., and Hadlock, C. J., & Pierce, J. R. put forth the KZ,

WW, and SA indicators, respectively [17-19]. 3. Models and indicators constructed by domestic scholars include the multivariate discriminant analysis method, the logistic regression method, and the random frontier model method [20]. This paper employs the binary logistic regression method in conjunction with the characteristics of China's science and technology SMEs to construct appropriate enterprise financing constraint variables [21].

In accordance with extant literature, this paper employs the interest coverage ratio (ICR) and enterprise size (Size) as grouping indicators. The sample data from each year are then arranged in descending order, with the first 33% of observations designated as the low financing constraint group and the last 33% as the high financing constraint group. If both indicators indicate low constraints, the sample is assigned to the low constraint group (coded as 1); if both indicators indicate high constraints, the sample is assigned to the high constraint group (coded as 0). The low constraint

group comprises 136 observations, while the high constraint group comprises 175 observations.

This paper selects the debt-to-equity ratio (LEV), return on assets (ROA), and net working capital (NWC) as indicators to measure the financing constraints of technology SMEs. The following logistic regression model is used to construct the financing constraint model:

$$FC = \alpha_0 + \alpha_1 LEV + \alpha_2 ROA + \alpha_3 NWC \quad (1)$$

### 3.2.2. Core explanatory variables

The China Digital Inclusive Finance Index, launched by the Digital Finance Research Center of Peking University, is based on data provided by Ant Financial and measures the development level of digital finance at the provincial and municipal levels (excluding Hong Kong, Macao, and Taiwan). This article employs the Index's provincial data as an indicator to measure the level of FinTech development.

**Table 1.** Variable definition

Variables	code	definition
Financing constraints	FC	The indicators are constructed by logistic regression model.
FinTech Development Indicators	FinTech	China Digital Financial Inclusion Index by the Peking University Digital Finance Research Center
Information Asymmetry	EA	(Net profit - cash flow from operating activities) / total assets at the end of the previous year
Return on assets	ROA	Net profit/total assets
Debt-to-asset ratio	LEV	Total Liabilities/Total Assets
Net working capital	NWC	Current assets - current liabilities
Growth Capacity	growth	Year-on-year growth rate of total operating income
Percentage of tangible assets	Tar	Tangible assets/total assets
Return on Equity	ROE	Net profit/shareholders' equity
Enterprise scale	size	Take the logarithm of total assets
Net profit margin	NPM	Net profit/sales revenue

### 3.3. Methodology

This paper uses a fixed effect model to prove the impact of FinTech development on the financing constraints of technology SMEs and the transmission mechanism of information asymmetry. The following general model is established:

$$FC_{it} = a_0 + a_1 Fintech_{it} + \delta Control_{it} + \varepsilon_{it} \quad (2)$$

Among them,  $FC_{it}$  is the financing constraints of technology-based SMEs;  $Fintech_{it}$  is the degree of development of FinTech;  $Control_{it}$  is a series of control variables;  $\varepsilon_{it}$  is the random error term;  $a_0$  is the intercept term;  $\delta$  is the estimated coefficient of the control variable;  $a_1$  is  $Fintech_{it}$  the estimated coefficient of. If  $a_1 < 0$ , then the development of FinTech can alleviate the financing constraints of technology-based SMEs.

### 3.4. Mediation Effect Model

This paper posits that the advancement of financial technology (FinTech) can mitigate information asymmetry, thereby alleviating the financing constraints faced by technology-oriented small and medium-sized enterprises (SMEs). To substantiate the existence of this mechanism, a new equation will be formulated and validated based on the overarching model. Bhattacharya et al. (2003) put forth the proposition that earnings aggressiveness and loss aversion indicators may be employed to ascertain the degree of

transparency in accounting information [22]. As corporate transparency increases, the degree of information asymmetry between investors is reduced. In the research of You, Jiaying & Li, Bin., earnings aggressiveness (EA) is used to measure the degree of information asymmetry [23]. It is posited that as EA increases, so too does the degree of information asymmetry. The following equation group is constructed:

$$EA_{it} = (NP_{it} - NCF_{it}) / Asset_{it-1} \quad (3)$$

$$EA_{it} = a_0 + a_1 Fintech_{it} + dControl_{it} + e_{it} \quad (4)$$

$$FC_{it} = a_0 + a_1 Fintech_{it} + \varphi EA_{it} + \delta Control_{it} + \varepsilon_{it} \quad (5)$$

In the aforementioned indicators, the subscripts "i" and "t" represent the individual enterprise and year, respectively. The variable "EA" represents earnings aggressiveness, the variable "NP" represents net profit in year t, the variable "NCF" represents net cash flow from operating activities of the company in year t, and the variable "TA" represents total assets at the end of year t-1. Equation (5) introduces the earnings aggressiveness (EA) proxy variable as a measurement indicator based on the overall model.

## 4. Empirical Results

### 4.1. Financing Constraint Index Construction Results

A difference t-test was conducted on the enterprise financing constraint index of model 1. The results

demonstrated that the selected index exhibited notable disparities between the two groups of samples, thereby substantiating the effectiveness of the index. Furthermore, the

inflation factor calculation yielded an average inflation factor of 1.06, which was <2, indicating the absence of significant multicollinearity between the variables.

**Table 2.** Differential t-tests and inflation factors

variable	Financing constraints	Dependent Variable	Mean difference and significance	Expansion Factor
ROA	High Constraint	175	1.029***	1.09
	Low Constraint	136		
LEV	High Constraint	175	-0.927***	1.06
	Low Constraint	136		
NWC	High Constraint	175	0.446***	1.03
	Low Constraint	136		

As evidenced in Table 2, the results of the logistic regression analysis indicate that the Wald test results are all below the 5% significance level, thereby substantiating the existence of a discernible linear relationship between NWC, LEV, ROA, and the degree of financing constraints faced by technology SMEs. The ROC curve is employed to assess the goodness of fit of the regression model, with the model exhibiting an accuracy of 97.65%. In light of the aforementioned logistic regression results, the financing constraint indicators proposed in this study are as follows:

$$FC = -1.186 + 11.113ROA - 1.260LEV + 2.709NWC(6)$$

**Table 3.** Logistic regression results

variable	coef	std err	z	p
const	-1.186	0.31	-3.826	0.000
ROA	11.113	1.613	6.891	0.000
LEV	-1.26	0.319	-3.95	0.000
NWC	2.709	0.927	2.922	0.003

## 4.2. Descriptive Statistics

**Table 4.** Descriptive Statistics

	obs	mean	std.dev.	min	max
FC	919	-1.186	11.738	-106.902	81.787
FinTech	919	2.92E-16	1.001	-2.701	1.729
EA	919	3.57E-17	1.001	-6.785	13.163
Tar	919	3.82E-16	1.001	-3.648	2.008
growth	919	5.00E-17	1.001	-0.158	20.703
ROE	919	2.91E-17	1.001	-30.213	0.619
NPM	919	-1.83E-18	1.001	-25.961	0.068
Asset	919	9.85E-17	1.001	-0.283	17.000

## 4.3. Variable Correlation Analysis

As evidenced by the correlation analysis results presented in Table 4, there is a negative correlation between FC and FinTech, and a positive correlation between FC and EA. This aligns with the initial hypothesis. Following the multicollinearity test, the average inflation factor for each variable was found to be 1.05, which is below the threshold of 2. It can be concluded that there is no significant multicollinearity between the indicators, and that empirical analysis can be conducted.

**Table 5.** Variable correlation analysis

	FC	FinTech	EA	Tar	growth	ROE	NPM	Asset
FC	1.000							
FinTech	-0.045	1.000						
EA	0.578***	0.0124	1.000					
Tar	0.347***	0.191***	0.126**	1.000				
growth	-0.091**	0.022	-0.011	0.026	1.000			
ROE	0.334***	-0.040	0.227***	0.096**	-0.002	1.000		
NPM	0.250***	-0.078*	0.079*	0.018	0.007	0.140***	1.000	
Asset	0.002	-0.067*	-0.075*	-0.156***	0.002	0.005	0.009	1.000

## 4.4. Benchmark Regression Model Results

The regression results are presented in Table 5. The data in column (1) indicate a significant positive correlation between information asymmetry and the degree of corporate financing constraints. This implies that as information asymmetry increases, so too does the severity of financing constraints face by technology SMEs. Consequently, hypothesis 1 is supported. In contrast, the data in column (2) show a significantly negative coefficient for the FinTech development indicator. This suggests that the advancement of FinTech plays a pivotal role in alleviating the financing constraints experienced by technology SMEs.

**Table 6.** Benchmark regression model results

	(1)	(2)
	FC	FC
FinTech		-0.9247*** (0.3518)
Constant term	-1.1860***(0.2771)	-1.1860*** (0.3303)
EA	5.7832***(0.3044)	
Tar	3.3153***(0.2874)	3.9289*** (0.3466)
growth	-1.1490***(0.2909)	-1.3492*** (0.3437)
ROE	1.9819***(0.2909)	3.2156*** (0.3350)
NPM	2.2182***(0.3120)	2.3917*** (0.3688)
Asset	0.9689***(0.2840)	0.7710** (0.3366)
Individual Effect	Yes	Yes
Time Effect	Yes	Yes
Observations	919	919
R-square	0.5059	0.3098

## 5. Testing of Mediating Mechanisms

An enterprise may be classified as belonging to either the high information asymmetry group or the low information asymmetry group, depending on the extent of information asymmetry present. As evidenced by the data presented in Table 6, the advancement of FinTech does not appear to mitigate the information asymmetry experienced by enterprises within the high information asymmetry group. This observation challenges the initial hypothesis. This may be due to the fact that the sample size within this interval is more significantly influenced by individual factors, and the local FinTech development indicators are unable to accurately assess the advancement of FinTech, resulting in discrepancies.

Accordingly, the high information asymmetry group was excluded from the original data set to allow for a mediating mechanism test to be conducted. In the low information asymmetry group, the development of FinTech is negatively correlated with the degree of information asymmetry of enterprises, indicating that the former can alleviate the latter. In column (3), the coefficient for FinTech is significantly negative, indicating that the development of FinTech can alleviate the financing constraints of technology SMEs. The regression of model (5) shows that the coefficient for FinTech and the coefficient for EA remain unchanged, indicating that the development of FinTech can reduce information asymmetry and thus alleviate the financing constraints of technology SMEs, thereby verifying hypothesis 2.

**Table 7.** Mediating mechanisms test results

	High information asymmetry group	Low information asymmetry group	(3)	(4)
	EA	EA	FC	FC
FinTech	0.1977** (0.0886)	-0.0968*** (0.0338)	-2.8488*** (0.7316)	-1.6701*** (0.6101)
Constant term	0.7716 (3.0431)	-0.3990*** (0.0199)	-2.8205*** (0.4310)	2.0381*** (0.4768)
EA				12.1755*** (0.7932)
Tar	0.0859 (0.0745)	0.0259 (0.0204)	3.8298*** (0.4421)	3.5141*** (0.3663)
growth	4.0783*** (0.9198)	-0.0052 (0.01615)	-1.2208*** (0.3494)	-1.1575*** (0.2891)
ROE	6.6309*** (1.4306)	0.1867*** (0.0159)	2.7030*** (0.3433)	0.4290 (0.3204)
NPM	-5.9872 (51.9520)	0.0329 (0.0308)	3.7483*** (0.6664)	3.3475*** (0.5520)
Asset	-0.2081 (0.2698)	0.0019 (0.0159)	1.0557*** (0.3454)	1.0316*** (0.2858)
Individual Effect	Yes	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes	Yes
Observations	372	540	540	540
R-square	0,3558	0.2768	0.3509	0.5565

## 6. Robustness Test

Enterprises that are constrained by limitations in their access to financing, particularly those operating at the small and medium-sized technology enterprise level, encounter significant challenges in obtaining the necessary funds through conventional channels. These entities utilize existing cash flows to fulfill demand or support investment, thereby demonstrating a high degree of sensitivity to cash-to-cash flow ratios. An increase in sensitivity corresponds with an

elevated degree of financing constraints for the enterprise. This paper builds upon existing literature by introducing a control variable indicator, short-term debt changes rate (SD), which can reflect cash-cash flow sensitivity [24, 25]. This indicator provides investors and creditors with insights into the stability of debt and the evolving financial status of the enterprise. The regression results presented above are subjected to a stability test. The results in Table 7 demonstrate that the replacement of variables does not affect the validity of Hypotheses 1 and 2.

**Table 8.** Robustness tests

	(1)	(2)	(3)
	FC	FC	FC
FinTech	-0.8629** (0.3557)		-1.0097*** (0.2987)
Constant term	-1.1860*** (0.2771)	-1.0135*** (0.2873)	-1.0238*** (0.2857)
EA		5.7852*** (0.3057)	5.8116*** (0.3040)
Tar	3.9197*** (0.3495)	3.3212*** (0.2891)	3.5323*** (0.2941)
growth	-1.3521*** (0.3445)	-1.1616*** (0.2911)	-1.1821*** (0.2894)
ROE	3.2106*** (0.3357)	1.9769*** (0.2910)	1.9172*** (0.2898)
NPM	2.3705*** (0.3699)	2.1889*** (0.3124)	2.1499*** (0.3108)
Asset	0.8247*** (0.3397)	1.0250*** (0.2862)	1.1059*** (0.2855)
SD	-0.8310 (0.5306)	-1.0527** (0.4479)	-1.0005** (0.4456)
Individual Effect	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes
Observations	905	905	905
R-square	0.3140	0.5107	0.5170

## 7. Conclusion and Policy Recommendations

This paper employs data from the strategic emerging industry enterprises of the Science and Technology Innovation Board from 2016 to 2020 as a sample for the construction of a financing constraint index for science and technology SMEs. The introduction of the mediating variable indicator information asymmetry is accompanied by the use of a double fixed effect model to prove the impact of FinTech development on the financing constraints of science and technology SMEs. The empirical results demonstrate that the advancement of FinTech for science and technology SMEs can enhance the level of information asymmetry between them and investors. Furthermore, the development of FinTech can alleviate the financing constraints of science and technology SMEs. The alleviation of these constraints is achieved through the reduction of information asymmetry.

In order for FinTech to more effectively support the growth of technology-focused SMEs, two primary avenues of intervention have been identified.

(1) It is recommended that the government encourage financial institutions to utilize technologies such as big data and cloud computing to establish a robust information monitoring and processing system and risk control system. This will facilitate the optimization of financial service processes, enhance financial service efficiency, and expand financing channels and areas, thereby providing more robust financial support for small and medium-sized enterprises. This will facilitate the healthy and rapid development of digital finance, reinforce the construction of digital financial infrastructure, expand the range of digital financial products and services, reduce application costs, and enhance convenience, thereby providing a conducive financing environment for R&D and innovation of small and medium-sized enterprises.

(2) Small and medium-sized technology companies should enhance their internal management practices, utilize the Internet, blockchain technology, and other digital tools to streamline the aggregation of operational data, refine the quality of credit data, and thereby augment the credit capital available to enterprises. The accelerated review of non-financial information and issuance of loans can be achieved through the development of technologies such as big data credit assessment, thereby reducing financing costs. The advancement of FinTech, the mining of extensive data through information technology, and the reasonable matching of credit resources with the technological innovation projects of enterprises can be facilitated to avoid adverse selection and moral hazard problems.

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