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Can Fintech Alleviate the Financing Constraints of Enterprises?—Evidence from the Chinese Securities Market

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Abstract: Whether Fintech enabled by big data technology can improve the efficiency of credit allocation and how it would do has always been the focus in the capital market, especially the intermediary mechanism, which has not yet been convincingly explained. This paper empirically tests the logical relationship and micro mechanism between Fintech and the corporate financing constraint dilemma by using the data of China's A-share non-financial listed companies from 2011 to 2018. The research found that Fintech has a significant mitigation effect on corporate financing constraints, and the coverage capability of Fintech has a stronger mitigation effect compared to the depth of use. Mechanism research shows that the "technology enabling" role of Fintech can alleviate the financing constraints of enterprises by reducing the degree of information asymmetry between capital supply and demand sides and reducing financing costs. Heterogeneity research shows that the mitigation effect of Fintech on corporate financing constraints is more significant in enterprises with private property, non-main board listing, senior executives with high financial literacy, and enterprises with strong competitive positions in the industry. Further research shows that, in order to identify the impact of Fintech on corporate financing types under an environment without internal control defects, Fintech enables enterprises facing financing constraints to obtain more commercial credit and bank loans; at a time when it is difficult to obtain bank loans, commercial credit has become an alternative financing method of bank loans, promoting the transfer of credit resources from traditional mortgage guarantees to enterprise commercial credit. This study provides a perspective for the research on how Fintech alleviates corporate financing constraints, and it reveals the characteristics of digital empowerment in the development of China's capital market, providing a theoretical basis and evidence supporting the formulation of relevant policies.

Keywords: Fintech; financing constraints; technology empowerment; information effect; cost effects

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Citation: Lyu, Y.; Ji, Z.; Zhang, X.; Zhan, Z. Can Fintech Alleviate the Financing Constraints of Enterprises?—Evidence from the Chinese Securities Market. *Sustainability* **2023**, *15*, 3876. https://doi.org/10.3390/su15053876

Academic Editors: David G. Fernandez and John Beirne

Received: 30 December 2022
Revised: 15 February 2023
Accepted: 19 February 2023
Published: 21 February 2023

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1. Introduction

China's economic development over the last quarter century has been phenomenal, making it the world's second-largest economy (World Bank, 2022). At the same time, Fintech in China has made great progress and has had a great influence on the world [1]. Ant Financial Services, WeBank, JD Finance and other leading financial technology enterprises among rank the world's leaders in the fields of mobile payment, credit and investment. In 2019, the transaction scale of China's mobile payment market exceeded CNY 200 trillion (The data comes from <The Research Report on the Value of China's Financial Technology in 2019> by We-Bank&iResearch; <Global Financial Technology Top 100 (2018)> by KPMG and H2 Ventures). Among them, WeBank directly puts in and connects the transaction information (such as capital flow and information flow) of small- and medium-sized enterprises through relevant modules, bypasses the traditional financial institutions to capture key information from core enterprises, and provides services such as cash management,

payment and settlement, and credit support. By 2020, WeBank had established a docking and cooperation network with more than 200 core enterprises in the supply chain, providing nearly CNY 65 billion in financing support for more than 100,000 small and micro enterprises in the upstream and downstream, which increased their financing limit by nearly 70% and reduced the financing cost by nearly 15%.

Fintech is the integration of "finance" and "technology" [2]. The advantages of Internet and big data technology applied to financial services such as mobile payment, digital insurance, investment and information lending are obvious. Many studies have shown that emerging technologies have changed financial services by making transactions cheaper, more convenient and safer [3,4]. However, some studies believe that the promotion of Fintech in developed financial markets will increase the vulnerability of existing financial institutions and destroy their stability. Fintech can be regarded as a direct competitor of traditional financial institutions [5], and market discipline can mitigate this effect [6].

Fintech can enjoy the opportunity of rapid development. Only when the existing or traditional financial system is underdeveloped can it affect enterprise financing, especially in most developing countries. Therefore, as mentioned above, especially in developing economies such as China, the relationship between Fintech and traditional financial systems can be complicated.

In view of the imperfection of the capital market and the high external financing cost of enterprises, the financing constraint problem [7], which leads to investment lower than the optimal investment level, has always been an important research topic in the field of corporate finance. In recent years, as an emerging financial industry, Fintech has optimized the traditional financial service mode [8] by relying on cloud computing, big data and other information technologies, and it breaks through the bottleneck of the traditional financial system and expands the scope of financial supply for enterprises blocked by credit channels [9]. However, detailed research on the mechanism, heterogeneity characteristics and financing types of the new financial formats affecting the financing decision-making behavior of enterprises is still relatively limited, which will undoubtedly lead to the passivation of relevant policies. This research is just trying to make up for it.

As far as corporate financing constraints are concerned, existing researchers believe that competition in the banking industry, financial linkages, and the size and structure of the financial system block corporate financing behavior. Therefore, improving the level of financial development and increasing the financing proportion of small and medium-sized banks with high operational flexibility can effectively alleviate corporate financing constraints [10,11]. Recent researchers have included Fintech into the research on the availability of micro-enterprise financing. Fintech has played a role in alleviating the financing difficulties of enterprises by optimizing the direct and indirect financing system, corporate transparency and corporate social responsibility [12].

Whether and how Fintech can play a mitigating effect on the financing difficulties faced by enterprises is discussed in this paper. Based on this, this paper matches the data of A-share non-financial listed companies in the Shanghai and Shenzhen Stock Exchanges in China from 2011 to 2018 with relevant urban data, aiming to analyze the mitigation effect of Fintech as a new financial format in corporate financing constraints, and to discuss the intermediary mechanism between Fintech and corporate financing constraints. The different impacts of Fintech on corporate financing constraints in terms of regional attributes, senior executives' financial background, property rights attributes, stock market segment, and the competitive position of enterprises in the industry is explored. At the same time, this paper provides new evidence for the relationship between the Fintech, commercial credit and bank loans.

The parts of this paper are arranged as follows: Section 2 reviews the relevant literature on Fintech and corporate financing constraints, and puts forward research assumptions accordingly; Section 3 is the research methods of this paper; Section 4 is the empirical results and analysis; Section 5 is the mechanism test of Fintech to ease the financing constraints of

enterprises; Section 6 discusses the influence of Fintech on the types of enterprise financing; Section 7 is conclusions and discussion.

2. Literature Review

2.1. The Logic Relationship of Fintech and Corporate Financing Constraints

Due to the imperfection of the capital market, there is a significant difference between the internal and external financing costs of a company. Therefore, external financing is not a perfect substitute for internal financing. There is no complete substitution between the two financing ways. At this time, the enterprise will face financing constraints, and credit rationing occurs in credit markets under competitive equilibrium [13]. Credit resources are biased towards enterprises with an abundant cash flow and prevent enterprises from strong capital needs [14]. On the demand side, the financing needs of state-owned enterprises with invisible guarantees have squeezed out enterprises with a shortage of collateral and low financial transparency, and the "crowding out effect" of small and medium-sized private enterprises occurs when enterprises are subjected to financial discrimination. The difficulty of obtaining the funds needed for enterprise operation [15] seriously weakens the competitiveness of an enterprise.

The internal evolution of Fintech will alleviate the above corporate financing constraints to a certain extent. First of all, the integration of Fintech and deep learning algorithms is convenient for intelligently identifying the needs of many and scattered investors in the financial market to broaden the scope of investment needs and expand financing increments; secondly, blockchain technology has driven the capital market in the direction of information transparency and clear rules, which has improved the quality of financing. Fintech has promoted the integration and innovation of credit services. Digital technologies have empowered traditional financial institutions through tracking enterprise operating conditions and credit information, which optimize the identification problems of bank-enterprise information asymmetry and credit risk.

From the perspective of enterprise information mining, enterprise-structured data is generally represented by quantitative data, which can be mined with low value, while non-structured data is represented by data with variable fields, which usually accounts for more than half of the enterprise data and has a large value but a higher demand for mining tools. Fintech can use text mining technology to transform unstructured information to structured information [16] for financial institutions to grasp more corporate financial conditions and have future profitability. The text mining technology using multi-dimensional data make credit decisions easier and let enterprises achieve credit self-certification in order to gain access to credit resources.

From the perspective of financial risk control, under at level of traditional bank risk-control technology, the existence of factors such as high information search cost, lagging information acquisition and a single credit standard makes the credit assessment of enterprises biased, and it is difficult to suppress credit risks. The risk control principles of traditional financial institutions mostly rely on corporate collateral, and bank credit is mostly favored by large enterprises, but it is more difficult for small and medium-sized enterprises that lack sufficient collateral to obtain bank institutional loans [17]. In addition, internal corporate governance affects access to capital and the investment portfolio of enterprises (Dang, 2021). From an information sharing perspective, adequate loan information can reduce the cost of monitoring [18]. With the help of big data, cloud computing, and Internet technology, Fintech has reconstructed the credit system and the risk early warning mechanism of the credit market, effectively alleviating credit risk problems.

This paper proposes:

Hypothesis 1. *Fintech can effectively alleviate corporate financing constraints.*

2.2. The Mechanism of Fintech to Alleviate the Financing Constraints of Enterprises: Information Effect

The theory of financial advantage under imperfect markets was first introduced into the study of information asymmetry in the capital market, and it was believed that the degree of financing constraints faced by enterprises was positively correlated with the degree of information asymmetry [19,20]. In an imperfect capital market, the information asymmetry of banks and enterprises has led to adverse selection and moral hazard problems, and enterprises will face financing constraints [21]. At the same time, credit markets are so inherently asymmetrical in information that banks can get a "winner's curse" when competing for customers [22]. That is to say, in order to achieve the goal of winning the number of customers in the competitive market structure, it is impossible to avoid obtaining low-quality customers under the condition that the real information of the enterprise is not complete, and the bank will suffer the loss of benefits and fall into the "winner's curse" [23]; thus, mining more business information is a prerequisite for making credit decisions.

First of all, the digital technology endowment of Fintech has a natural advantage in corporate information collection. The advantage of economies of scale in financial intermediary information collection alleviates the information asymmetry between the supply and demand sides of funds [24]. Fintech uses big data technology to accurately identify the operating conditions of enterprises, intelligently collect the multidimensional data of enterprise operating conditions, dynamically monitor the structured data of enterprises, dig into unstructured information, and transform transaction information such as enterprise capital flow, commodity flow, and information flow into credit records. The higher the value of credit capital, the greater the probability of credit support for enterprises [25].

Secondly, Fintech has the function of signal transmission, which significantly alleviates the degree of information asymmetry. When the financial ecological environment and the financial system are still imperfect, informal systems make up for the deficiencies of formal systems, such as the supervision of collateral in the credit market in corporate financing. Informal system factors such as political capital, corporate culture, corporate social responsibility and so on, which are the source channels of corporate signal transmission behavior, often appear less in the formal information disclosure of enterprises. Big data technology can improve the recognition of external investors to a certain extent and send an "efficiency" reputation signal to the capital market.

Finally, Fintech restricts corporate defaults and forces them to improve the quality of information disclosure. With the application and popularization of big data technology in the credit appraisal system, the coupling degree between the market value of enterprises and the credit appraisal system has been increased, and the lack of information between banks and enterprises in identifying credit risks has been improved. Specifically, Fintech empowers financial products and financial services through big data technology, and its integrated development gets rid of the dependence of the capital supply side on corporate collateral. Enterprises pay more attention to improving their credit rating through the detailed disclosure of operating conditions, thus encouraging managers to practice the principle of integrity and provide high-quality disclosure information for the obtaining and broadening of financing channels.

This paper proposes:

Hypothesis 2. *Fintech effectively alleviates the corporate financing constraints by reducing the internal and external information asymmetry of enterprises.*

2.3. Mechanism of Fintech to Alleviate Corporate Financing Constraints: Cost Effect

High financing costs and high leverage are related to enterprises making business decisions and cultivating competitive advantages, which are important indicators for measuring corporate liabilities and operational risks, and are also the key basis for external

investors' financial support decisions. The increase in leverage will compress corporate profits and increase corporate operational risks [26].

However, the tightening of credit policies and the stickiness of corporate costs have led to high financing costs for enterprises. First of all, the high level of credit risk leads to the marginal contraction of credit, and financial institutions will increase the threshold and cost of borrowing for credit risk considerations, and they will increase the cost pressure of capital acquisition for enterprises. The tightening of credit policies has led enterprises to meet credit or regulatory requirements, giving rise to the multi-channel nesting of financing businesses, lengthening the credit intermediary chain and thus bringing about the problem of excessive financing costs; in addition, credit resources are skewed towards large enterprises to squeeze out the financing needs of small and medium-sized enterprises, indirectly raising the cost of obtaining funds. Second, the viscosity of enterprise costs damages the short-term value of enterprises and raises the cost of using funds when acquiring credit capital. Cost stickiness refers to the asymmetry phenomenon that the proportion of cost changes with the fluctuation of business volume, which is manifested as the proportion of cost and expense increase when the business volume increase is greater than the proportion of the cost and expense decrease when the business volume decreases. Corporate executives, out of self-interest, often over-invest when the company's sales increase; when sales decline, they do not cut the input, resulting in the generation of cost stickiness, which leads to the increase in unit costs when the volume of business decreases, and corporate profits are greatly compressed. Therefore, the cost stickiness of the enterprise expands the decline in corporate surpluses [27–29], which undermines the corporate value in credit markets and is not conducive to the obtaining of external financing.

Fintech based on big data technology reduces the cost of using funds for enterprises. On the one hand, "data" is the carrier of the financial market. Digital technology empowers traditional financial institutions to classify users' accurate portraits according to demand scenarios and intelligently mine enterprise credit data, providing a feasible way to reduce market friction and reduce the financing threshold [30]. Particularly, the application of cloud computing and blockchain technology has expanded the scope of information sharing, which is conducive to achieving scale economies in the process of information collection and transaction matching in the credit market, and reducing the information processing costs [31,32]. On the other hand, the equity crowdfunding, wealth management functions, and payment and settlement functions covered by Fintech provide diversified financing channels for enterprise operations and inhibit the leverage financing needs of enterprises. Among them, the equity crowdfunding function of Fintech provides enterprises with effective funds, increases the proportion of equity assets in the balance sheet, increases the total assets and profits of enterprises, and reduces the leverage ratio of enterprises. Similarly, wealth management adds additional benefits to a company's idle funds and helps reduce leverage. Additionally, the new payment and settlement methods break through the shackles of time and space, and they are better than traditional cash, remittance, cheques and other payment methods in terms of capital turnover speed, settlement efficiency, security and stability, which forms a network scale effect and reduces the transaction cost and capital usage cost for the enterprises [33].

This paper proposes:

Hypothesis 3. *Fintech enhances the financial acquisition ability of enterprises by reducing the financial cost of enterprises and reducing the leverage ratio of enterprises.*

2.4. Literature Gap

There are three differences that distinguish our research from other studies on Fintech and corporate financing constraints. Compared with the existing literature, the following are the marginal contributions of this paper: First, the relationship between Fintech and traditional financial systems can be complicated, especially in developing economies, so we focus on China and expand the research regarding developing economies. Second,

the existing literature on the information asymmetry in capital market is mostly seen in experience analysis [34]. This paper uses the research of financial market micro-structures for reference [35] and uses the daily frequency trading data of the securities market to construct the information asymmetry index between funds' supply and demand. In addition, the intermediary mechanism identification of information asymmetry and financing cost enriches the research on corporate financing constraints. Thirdly, commercial credit and bank loans are the two main external financing methods for enterprises. The existing literature on the interaction between Fintech development and commercial credit and bank loans is still lacking. This paper analyzes the impact of Fintech on corporate debt financing (mainly including commercial credit and bank credit) under the internal control quality of enterprise heterogeneity, as well as the alternative relationship between the two debt financing methods.

3. Materials and Methods

3.1. Data Source

To test the above hypotheses, we focused on data from China. We used the A-share enterprises listed in Shanghai and Shenzhen A-share stock exchanges from 2011 to 2018 as a study sample and matched them with Fintech data to build a sample data-set. Specifically, the enterprise financial data involved in the study are from the CSMAR and RESSET database, Fintech data were obtained from the PKU-FinTech Inclusive Index of the Peking University Digital Finance Research Center, and the regional-level data were from the China Urban Statistical Yearbook. We cleaned the original data by excluding (1) banks, securities, insurance, and other financial companies; (2) ST shares, *ST shares, and stocks that were delisted during the sample period. The continuous variables were shrunk by 1% quantile on both sides to avoid the influence of abnormal value "noise", and 16,282 sample observations were finally obtained.

3.2. Models

In order to test whether Fintech alleviates corporate financing constraints, the following fixed effect model is constructed in this paper, and the expression is as follows:

$$SAindex_{ijt} = \alpha_0 + \beta_1 \text{Fintech}_{jt} + \sum \phi CV_{ijt} + year + u + \varepsilon_{ijt} \quad (1)$$

In model (1), $SAindex_{ijt}$ represents the degree of financing constraint of the j city i enterprise at t time, which is the interpreted variable of this document; $Fintech_{jt}$ represents the level of Fintech development of the j city at t time and is an independent variable; CV represents a set of control variables that affect enterprises' financing constraints. Variable *year* is the year dummy variable; u is the enterprise individual effect (the influence of non-time-changing, unobservable corporate trait factors on the enterprises' financing constraints); ε_{ijt} is a random error term that is independent of the same distribution. Further, this paper uses firm-level clustering robustness standard errors in regression testing. According to the above research analysis, if Hypothesis 1 is true, $\beta 1 < 0$; that is, the Fintech can reduce enterprises' financing constraints.

3.3. Variables

3.3.1. Dependent Variable: Financing Constraints (FC)

Rooted in the imperfection of the capital market, scholars have made many explorations and tests to quantify corporate financing constraints under the condition of information asymmetry [36–38]. Based on the fact that the SA index has the advantages of strong exogenousness and the stable measurement of the obtained variables, and has been widely used in the field of domestic and foreign corporate financing constraints, we use the SA Index as an estimate of corporate financing constraints to be consistent with the mainstream literature, drawing on the method used by Hadlock and Pierce [39]. According to corporate asset and firm age, we use China A-Share-listed companies as a sample to construct the SA

Index to measure the degree of corporate financing constraints. The specific calculation method of the SA Index is as follows: SA = $-0.737 \times \ln(\text{Asset}) + 0.043 \times \ln(\text{Asset})^2 - 0.04 \times$ Firm age. Using the estimated results of this regression model, we can calculate the SA index for the degree of financing constraint for each listed company. The SA index takes the absolute value, and the larger the value of the SA index, the greater the financing constraints.

In the robustness test of this paper, the KZ index is used to verify the basic conclusion [40]. The calculation method of the KZ index is as follows: KZ index = -6.315 * CF_{it}/A_{it-1} + 0.460 * Tobin's Q + 3.291 * LEV_{it} − 39.356 * DIV_{it}/A_{it-1} − 3.494 * C_{it}/A_{it-1}. The larger the value of the KZ index, the greater financing constraints. Specifically, CF_{it} is operating net cash flow; A_{it-1} is total assets of the previous period; Tobin's Q is growth indicators of enterprises; LEV_{it} is total liabilities of the current period; DIV_{it} is cash dividends; and C_{it} is cash holdings. The estimated coefficients of each variable in the formula are obtained through ordered logical regression.

3.3.2. Independent Variable: Fintech

Following Guo et al. (2019) [41], we measure FINTECH_1 as the logarithmic PKU-FinTech, which is our independent variable. PKU-FinTech Inclusive Index stems from the Peking University Digital Finance Research Center to measure the level of Fintech development in 337 cities in China. The PKU-FinTech Inclusive Index is three-dimensional data covered by a coverage index (the number of users), use depth index (including payment, investment, credit, and other business areas), and digital index (convenience and number of mobile payments), which provides a comprehensive evaluation standard for further the analysis of the current situation of Fintech development in the region. The empirical analysis part of this paper uniformly uses the Fintech index at the municipal level to characterize the level of Fintech development of the 337 cities, and normalizes the index.

3.3.3. Mediators

In this paper, information asymmetry (ASY) and financing cost (FE) were selected as intermediary variables, and the microscopic mechanism of Fintech on corporate financing constraints was studied based on two paths: signal effect and resource effect.

(1) Information Asymmetry (ASY):

The first mediator is Information Asymmetry (ASY), which may cause credit risk between financial institutions and enterprises and may weaken the information screening ability of the capital market. With the improvement of relevant theories on financial market microstructure, scholars have explored the measurement methods of asymmetric information indicators from different perspectives in order to capture the information asymmetry between trading parties in the capital market. In early research, bid–ask spread was used to measure information asymmetry. Huang (1997) [42] believed that market makers compensated for their losses after trading with informed traders by increasing the spread. The effective spread was divided into two parts, namely, market makers' realizable gains and adverse selection costs. Easley (2004) [35] constructed an informed transaction probability indicator PIN value to measure the degree of information asymmetry according to the imbalance of purchase and sales orders within a given time period. However, these measurement methods need to obtain high-frequency transactions using transaction data, which may be difficult to obtain in some sample periods. On the contrary, it is less difficult to obtain high-frequency time-sharing data, which does not depend on the matching of quotation data and transaction data. The information asymmetry model and indicators based on high-frequency time-sharing data include the HS model, PCL measurement indicators, Amihud non liquidity indicators, and the bid price difference for measuring transaction costs [43].

This paper draws on the research of the existing financial market microstructure based on the principle of the availability of daily frequency trading data in the securities market and the objective and comprehensive construction of indicators, and adopts Yu Wei's

(2012) [44] strategy to identify the degree of information asymmetry. The specific idea is to build liquidity ratios (Roll), illiquidity indicators (ILLIQ), and yield inversion indicators (Zeros), and use the principal component analysis method to extract the first principal component of the three indicators and to extract the relevant components of asymmetric information. As the proxy variable of information asymmetry (ASY), the higher the ASY level, the higher the degree of information asymmetry.

The liquidity ratio calculation method is $Roll_{it} = -\frac{1}{D}\sum_{k=1}^{D_{it}} \sqrt{\frac{V_{it}(k)}{|r_{it}(k)|}}$; the illiquid ratio is $ILLIQ_{it} = -\frac{1}{D}\sum_{k=1}^{Dit} \sqrt{\frac{|r_{it}(k)|}{V_{it}(k)}}$. The yield reversal indicator, $Zeros = |\gamma_{it}|$, γ_{it}, derived from the following formula:

$$r^e_{it}(k) = \theta_{it} + \varphi_{it} r_{it}(k-1) + \gamma_{it} V_{it}(k-1) sign[r^e_{it}(k-1)] + \varepsilon_{it}(k)$$

where D_{it} is the number of trading days in the current year, $V_{it}(k)$ is the number of stocks traded daily, $r_{it}(k)$ is the return rate of enterprise i on the k trading day in the t year, and $r^e_{it}(k)$ is the excess rate of return.

(2) Financial Expenses (FE):

The second mediator is financing Expenses (FE). Regarding the measurement of the financing costs, the existing research uses the ratio of corporate interest expense to the total debt of enterprises to measure the financing cost of corporate debt on the one hand [45], and on the other hand, the ratio of corporate financial expenses to the total of corporate liabilities at the end of the period. Since the debt financing process will not only generate the net interest expense of the enterprise loans but also generate the net exchange loss and the handling charges of financial institutions and other expenses incurred in raising funds, etc., the use of the ratio of enterprise interest expense to the enterprise's ending loan may cause the undervaluation of the enterprise's financing cost. To sum up, we used "the proportion of financial expenses in total liabilities" to measure the cost of corporate financial expenses; using the research of Lu Zhengfei for reference [46], we used "the proportion of total liabilities in total assets" to measure the level of enterprise leverage.

3.3.4. Control Variables

We include a number of control variables which are likely to impact the dependent variable. Because the formation of enterprises' financing constraints are inconsistent, this paper follows the existing research to control the relevant variables of corporate governance and regional economic development, which influence enterprise financing environment [47–49]. The management's shareholding ratio (Mshare) is measured by the ratio of the number of shares held by senior executives to the total number of shares. The cash stock (CF) is calculated as the company's cash on hand. The shareholding ratio of the largest shareholder (Top1) is calculated as the proportion of the listed company's shares held by the largest shareholder. Enterprise profitability (ROA) is measured by the ratio of net profit to total asset balance. Tobin Q reflects the enterprise's value and growth. Lastly, the regional economic variables are involved to improve the robustness of the regression results, including regional economic level (agdp), regional financial development (fd), foreign direct investment (fdi), etc. Table 1 presents variable symbols and definitions.

3.4. Descriptive Statistics

Table 2 lists the basic statistical characteristics of the major variables covered in this paper. Listed companies are faced with a distribution of the value of the financing constraint index in the range of 1.410 to 9.300, the minimum (maximum) value of the financing constraint (SAindex) is 1.410 (9.300), the average value is 4.060, and the standard deviation is 1.520, indicating that there is a large difference in the degree of financing constraints between the samples, and the typical facts of China's A-share listed companies facing different degrees of financing constraints were obtained from the original data analysis.

Table 1. Variable symbols and definitions.

Type	Variables	Symbol	Definition
Dependent Variable	SA index	SA	As described in the manuscript
	KZ index	KZ	As described in the manuscript
Independent Variable	Fintech	FINTECH_1	Logarithmic of Digital Financial Index (PKU-FinTech)
Mediators	Information Asymmetry	ASY	As described in the manuscript
	Financial Expenses	FE	The cost of corporate financial expenses (the proportion of financial expenses in total liabilities); the level of enterprise leverage (the proportion of total liabilities in total assets)
Control Variables	management's shareholding	Mshare	The number of shares held by senior executives/the total number of shares
	cash stock	CF	The company's cash on hand
	shareholding of the largest shareholder	Top1	The listed company's shares held by the largest shareholder
	Enterprise profitability	ROA	The net profit/total asset balance
	enterprise value	Tobin Q	The value of ending stock price × number of tradable shares + net assets per share × number of non-tradable shares + total liabilities)/total assets
	regional economic level	agdp	Logarithm of GDP per capita
	regional financial development	fd	The total regional deposits and loans/GDP
	foreign direct investment	fdi	Foreign direct investment/GDP

Table 2. Descriptive statistics.

Variables	N	Mean	Standard Deviation	50% Percentile	Min	Max
SAindex	16,493	4.060	1.520	3.810	1.410	9.300
FINTECH_1	16,493	5.150	0.420	5.250	3.060	5.710
Mshare	16,493	0.150	0.210	0.0100	0.0000	0.690
CF	16,493	0.040	0.070	0.0400	−0.170	0.240
Top1	16,493	35.23	14.94	33.43	8.770	74.96
ROA	16,493	0.040	0.050	0.040	−0.210	0.190
Tobin Q	16,493	2.670	1.940	2.030	0.880	11.44
agdp	16,493	14.10	11.20	11.81	1.810	50.63
fd	16,493	22.94	20.16	18.26	1.110	92.09
fdi	16,493	0.070	0.050	0.060	0.020	0.210

4. Results

4.1. Basic Regression Results

In order to test Hypothesis 1, Table 3 adopts the recursive regression method to avoid the multiple collinearity problem of the regression model. Column (1) in Table 3 only controls the Fintech development variable, column (2) adds the enterprise-level control variables, and column (3) adds the macroeconomic control variables to measure the

robustness of the results. The results show that the estimated coefficients of the Fintech (FINTECH_1) on the corporate financing constraint (SAindex) are significantly negative at the 1% level, which confirms that the higher the degree of Fintech, the lower the degree of corporate financing constraints. This shows that the Fintech has shown a driving force in alleviating the dilemma of corporate financing constraints. Therefore, H1 is supported.

Table 3. Basic model: impact of Fintech on corporate financing constraints.

Variables	(1)	(2)	(3)	(4)	(5)
	SAindex	SAindex	SAindex	Low-Financing Constraint Group	High-Financing Constraint Group
FINTECH_1	−0.4809 ***	−0.5221 ***	−0.4322 ***	−0.1314 *	−0.1971 **
	(0.0708)	(0.0666)	(0.0714)	(0.0719)	(0.0843)
Mshare		−0.4590 ***	−0.4553 ***	−0.0607	−0.4953 ***
		(0.0534)	(0.0534)	(0.0458)	(0.0927)
CF		−0.2869 ***	−0.2843 ***	−0.1700 ***	−0.2438 ***
		(0.0623)	(0.0623)	(0.0551)	(0.0783)
Top1		0.0004	0.0003	−0.0069 ***	−0.0015 *
		(0.0007)	(0.0007)	(0.0007)	(0.0008)
ROA		1.3531 ***	1.3577 ***	0.7482 ***	0.6997 ***
		(0.0890)	(0.0890)	(0.0746)	(0.1269)
Tobin Q		−0.1246 ***	−0.1246 ***	−0.0780 ***	−0.1309 ***
		(0.0031)	(0.0031)	(0.0025)	(0.0073)
agdp			−0.0060 *	−0.0007	0.0195 ***
			(0.0035)	(0.0033)	(0.0048)
fd			0.0045 ***	0.0054 ***	0.0012
			(0.0011)	(0.0011)	(0.0014)
fdi			−0.0401	0.1164	−0.0581
			(0.1722)	(0.1700)	(0.2039)
N	16,282	16,282	16,282	7972	8036
adj. R^2	0.9214	0.9306	0.9307	0.8174	0.9349
year FE	YES	YES	YES	YES	YES
firm FE	YES	YES	YES	YES	YES

* t-statistics based on standard errors clustered at the city level are reported beneath each coefficient estimate. Significance levels are indicated by *, **, *** for 10%, 5%, and 1%.

Columns (1)–(5) all control the "time–enterprise" fixed effect to verify Hypothesis 1 and show that the lack of collateral and credit history led to small and medium-sized enterprises having fewer opportunities to obtain financing. Fintech with distributed digital technology provides convenient conditions for enterprise financing, improving the availability of corporate financing.

Further, Table 3 demarcates the degree of corporate financing constraint (SAindex) at a 50% quantile to examine the difference in the utility of Fintech development to alleviate corporate financing constraints. The results of column (4) and (5) in Table 3 show that the estimated coefficient of Fintech (FINTECH_1) in the high financing constraint group is −0.1971, passing the 5% statistical significance test; in the low-financing constraint group, Fintech (FINTECH_1) had an estimated coefficient of −0.1314, passing only a 10% statistical significance test. This confirms that Fintech has more room for enterprises with high-financing constraints to mitigate their efficiency elasticity, and does not have much room for enterprises with low financing constraints.

4.2. Robustness Tests

To further enhance the robustness of the basic model, this article conducts the following tests: reconstruction of dependent variable explanatory variables, adding the high-order joint fixed effect of "province-time" and "industry-time", exclusion of municipal samples, multidimensional measurement of Fintech, and use of instrumental variables.

4.2.1. Reconstructing the Dependent Variables

Column (1) in Table 4 uses the KZindex method to reconstruct proxy variables of corporate financing constraints rather than the SA index to measure corporate financing constraints. As shown in column (1) of Table 4, the robustness test indicates that the

estimation coefficient of Fintech has passed the significance test at the level of 1%, and the benchmark conclusion in this paper is still robust.

Table 4. Robustness test.

Variables	Reconstructing the Dependent Variables	Replacing Regression Model	Exclusion of Municipal Samples	Multidimensional Measurement of Fintech		
	(1)	(2)	(3)	(4)	(5)	(6)
	KZindex	SAindex	SAindex	SAindex	SAindex	SAindex
FINTECH_1	−0.3940 *	−0.2064 **	−0.3837 ***			
	(0.2350)	(0.0936)	(0.0736)			
coverage_breadth				−0.2380 ***		
				(0.0582)		
usage_depth					−0.4534 ***	
					(0.0658)	
digitization_level						0.0055
						(0.0233)
Mshare	−1.1706 ***	−0.3701 ***	−0.3419 ***	−0.4594 ***	−0.4455 ***	−0.4608 ***
	(0.1618)	(0.0533)	(0.0573)	(0.0534)	(0.0534)	(0.0534)
CF	−9.0615 ***	−0.3187 ***	−0.3107 ***	−0.2804 ***	−0.2797 ***	−0.2772 ***
	(0.1971)	(0.0623)	(0.0697)	(0.0624)	(0.0623)	(0.0624)
Top1	−0.0116 ***	0.0004	0.0013 *	0.0003	0.0003	0.0002
	(0.0021)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
ROA	−14.0964 ***	1.2930 ***	1.3699 ***	1.3614 ***	1.3637 ***	1.3556 ***
	(0.4383)	(0.0889)	(0.0981)	(0.0891)	(0.0890)	(0.0891)
TobinQ	0.4794 ***	−0.1297 ***	−0.1204 ***	−0.1244 ***	−0.1244 ***	−0.1244 ***
	(0.0110)	(0.0032)	(0.0035)	(0.0031)	(0.0031)	(0.0031)
agdp	0.0003	0.0037	0.0006	−0.0047	−0.0079 **	−0.0044
	(0.0132)	(0.0054)	(0.0040)	(0.0035)	(0.0036)	(0.0035)
fd	0.0086 ***	0.0015	0.0038 ***	0.0048 ***	0.0057 ***	0.0059 ***
	(0.0033)	(0.0015)	(0.0012)	(0.0011)	(0.0011)	(0.0011)
Dfi	0.7231	−0.9475 ***	0.0082	−0.0953	0.0161	−0.0929
	(0.4996)	(0.3427)	(0.2440)	(0.1721)	(0.1726)	(0.1728)
N	11,212	16,282	12,990	16,282	16,282	16,282
adj. R^2	0.7083	0.9342	0.9220	0.9306	0.9307	0.9305
year FE	YES	YES	YES	YES	YES	YES
firm FE	YES	YES	YES	YES	YES	YES
province#year FE		YES				
indid#year FE		YES				

Significance levels are indicated by *, **, *** for 10%, 5%, and 1%.

4.2.2. Replacement Regression Model

Column (2) in Table 4 includes the method of Moser (2012) [50] and adds "province-time" and "industry-time" high-order joint fixed effects to the basic model to avoid endogenous problems caused by control time or individual fixed effects separately. As shown in column (2) of Table 4, the basic conclusion "Fintech helps alleviate the problem of corporate financing constraints" has not changed significantly.

4.2.3. Exclusion of Municipal Samples

Column (3) in Table 4 shows the results that exclude municipal samples. Considering the special location of the municipality directly under the central government, it has many policy preferences. Compared with other regions, there is heterogeneity in economic development, enterprise production and innovation activities. As shown in column (3) of Table 4, the estimated coefficient of Fintech is still significantly negative at the 1% statistical level after adding the enterprise-level control variables and regional-level control variables.

4.2.4. Multidimensional Measurement of Fintech

Column (4)–(6) in Table 4 shows the relationship between Fintech and corporate financing constraints, which is re-examined by using the multi-dimensional indicators of Fintech (coverage-breadth and usage-depth). As shown in column (4)–(6) of Table 4,

the coverage and usage depth of Fintech are significant at the statistical level of 1%, and both play an inhibitory role in corporate financing constraints, consistent with the basic benchmark conclusions.

4.2.5. Instrumental Variable Regression

In model (1), there may be some unobservable factors that affect Fintech and corporate financing constraints at the same time, leading to the problem of missing variables in the basic regression and the error in the estimation coefficient of Fintech. At the same time, the more serious enterprise financing constraints may also lead to a greater demand for Fintech, which may also lead to reverse causality. In addition, the sample size data may have measurement error problems. Therefore, in order to mitigate the endogenous bias caused by missing variables, reverse causality and measurement errors, this paper uses "Internet penetration rate in all provinces" as an instrumental variable and re-estimates the model using the two-stage least squares method (2SLS).

The main reasons for choosing this instrumental variable include, on the one hand, meeting the correlation requirements of instrumental variables and endogenous explanatory variables in Fintech. With emerging computer digital technologies such as big data, blockchain, computer, and cloud computing empowering the financial field, the innovation and technological application of digital financial products have been promoted to serve the real economy more effectively, especially for small and medium-sized enterprises; the screening characteristics of big data reduce the financing risk of industries and enterprises and improve financing compliance. Therefore, Internet penetration is highly correlated with Fintech. On the other hand, the requirement that the tool variable is not related to the perturbation term is satisfied. Iterative updating of Internet technology and coverage breadth have difficulty in directly affecting the financing needs of enterprises, and the development of the digital economy and the increase of networked infrastructure construction are promoted by government policies from top to bottom; as of June 2019, China's Internet penetration rate is as high 61.2% (Source: China Internet Network Information Center (CNNIC) 44th time <Statistical report on the development of China's Internet network>). The report of the Nineteenth National Congress also clearly put forward the requirements for developing the digital economy, building a network power, seizing the commanding heights of a new round of global industrial competition, and promoting the acceleration of transformation and upgrading of the real economy. Therefore, the Internet penetration rate is, to a certain extent, the impact of national policies and promoted by the government, which is exogenous. Therefore, the Internet penetration rate selected in this paper satisfies the correlation and exogenous assumptions of the instrumental variables.

Table 5 lists the two-stage regression (2SLS) results of the instrumental variables. In the first stage regression of column (1), the estimated coefficient of Iv is positive and significant at the 1% level, indicating that the higher the Internet penetration, the higher the Fintech. The estimated coefficient of Fintech in the second phase regression of column (2) is −1.2024, which is significant at the level of 1%, indicating that the basic conclusion of this paper is still valid after the potential endogenous problems are alleviated. In addition, the Durbin–Wu–Hausman statistic is 32.987 and the p value is 0.000 in the instrumental variables test in this paper, which rejects the exogenous explanatory variables, so it can be considered that the basic regression model has an endogenous problem at the 1% statistical level; the Kleibergen–Paap rk LM statistic is 1932.641, and the p value is 0.0000, which rejects the original assumption that cannot be identified; the Cragg–Donald Wald F statistic value is greater than empirical judgment 10, passing the weak instrumental variables test.

Table 5. Instrumental variable regression results.

Variables	(1)	(2)
	1st Stage	2nd Stage
	FINTECH_1	SAindex
Iv	0.0119 ***	
	(0.0003)	
FINTECH_1		−1.2024 ***
		(0.1699)
CVs	control	control
N	12,196	12,196
adj. R^2	0.9860	−0.0135
Year FE	YES	YES
firm FE	YES	YES
Durbin–Wu–Hausman	/	32.987
Kleibergen–Paap rk LM	/	1932.641
Kleibergen–Paap rk LM *p*-value	/	0.000
Cragg–Donald Wald F	/	1849.908

Significance levels are indicated by *** for 1%.

4.3. Heterogeneity Test

This paper examines the different impact of Fintech on corporate financing constraints in terms of regional attributes, senior executives' financial background, property rights attributes, stock market segments, and the competitive position of enterprises in the industry.

4.3.1. Heterogeneity in Region

The regional environment in which enterprises are located affects the financing behavior of enterprises. China's financial market has a strong geographical segmentation, and the development of Fintech needs to rely on traditional financial institutions to provide financing support, information and technology.

Table 6 reports the differences in financing constraints due to regional differences. In Column (1) of Table 6, the estimated coefficient for Fintech (FINTECH_1) is −0.5699 and at 1%, indicating that Fintech has alleviated the financing constraint dilemma of the enterprises in the eastern region.

Table 6. Heterogeneity analysis: region.

Variables	(1)	(2)	(3)
	Eastern	Central	Westward
FINTECH_1	−0.5699 ***	0.1230	−0.1573
	(0.1386)	(0.1529)	(0.1759)
CVs	control	control	control
Observations	9218	2838	1779
Adjusted R-squared	0.9340	0.9195	0.9245
Year FE	YES	YES	YES
firm FE	YES	YES	YES

Significance levels are indicated by *** for 1%.

4.3.2. Heterogeneity in Financial Background of Senior Executives

The top echelon theory believes that managers' personal experience and their financial background (The financial background of senior executives refers to whether the company introduces senior executives from policy banks, commercial banks, insurance companies, securities companies, fund management companies and other financial institutions) affect their cognitive ability and decision-making preference [51]. Senior executives with a financial background have a higher financial literacy and cognitive ability and are familiar

with risk–return principles and financing strategies, which helps to reach the fund-lending contract efficiently with low financing costs.

Column (2) in Table 7 reports that the coefficient is −0.5699, and it is significant at the statistical level of 1%, compared with enterprises with no financial background. This means Fintech has a significant impact on the enterprises with a financial background.

Table 7. Heterogeneity analysis: senior executive's background.

Variables	(1)	(2)
	No Financial Background	Have a Financial Background
FINTECH_1	0.0241	−0.3943 ***
	(0.1270)	(0.0883)
CVs	control	control
Observations	4225	11,455
Adjusted R-squared	0.9524	0.9362
Yeon FE	YES	YES
firm FE	YES	YES

Significance levels are indicated by *** for 1%.

4.3.3. Heterogeneity in Property Right and Stock Market Segment

First of all, the total sample is divided into two sub samples, namely, state-owned holding enterprises and private enterprises. Panel A in Table 8 shows that the coefficient of Fintech (FINTECH_1) is −0.1489 in the sample of state-owned holding enterprises, which is not significant. In the sample of private enterprises, the coefficient of Fintech (FINTECH_1) is −0.3601, which is significant at the level of 1%. The results show that the degree of financing constraints is inseparable from the nature of the enterprises. This is because private enterprises are developing rapidly, which leads to large financing gaps when pursuing economic scale expansion. Fintech increases the quality of enterprise information disclosure and weakens the information asymmetry, thus making it possible for private enterprises to fill the financing gap. Meanwhile, the existence of the soft budget constraints of state-owned enterprises increases the fund acquisition ability in state-owned enterprises from the government and state-owned banks, thus weakening the easing effect of Fintech on state-owned enterprise financing constraints.

Table 8. Heterogeneity analysis: corporate attributes and stock market segment types.

Variables	PanelA: Enterprise Nature		PanelB: Stock Market Segment	
	(1)	(2)	(3)	(4)
	State-Owned or State-Controlled Enterprises	Private Enterprises	Main Board	Non-Main Board
FINTECH_1	−0.1489	−0.3601 ***	0.0241	−0.3943 ***
	(0.0999)	(0.1042)	(0.1270)	(0.0883)
CVs	control	control	control	control
N	6650	8521	4225	11,455
Adjusted R-squared	0.9461	0.8975	0.9524	0.9362
Year FE	YES	YES	YES	YES
firm FE	YES	YES	YES	YES

Significance levels are indicated by *** for 1%.

Secondly, the characteristics of the enterprises in different listed sectors are quite different. Different stock market segment means that listed companies have a different capital scale, profitability and ability to obtain sufficient or excess financing cash. Panel B in Table 8 reports that the estimated coefficient of Fintech (FINTECH_1) is not significant in the main board. The estimated coefficient of Fintech (FINTECH_1) is −0.3943 in the non-main-board-listed enterprises, which is significant at the level of 1%. This shows that

Fintech mainly alleviates the financing constraints of non-main board enterprises with relatively small capital scale but high growth.

4.3.4. Heterogeneity in Competitive Position of Enterprises in the Industry

The competitive position of enterprises directly affects the external financing of enterprises. Enterprises with a low competitive position, as price receivers and the party with low market share, lack subjective initiative in the procurement and sales links, which further brings about difficulties in "blood making". However, enterprises in a competitive position, as industry predators, have sustained market competitiveness and comparative advantages, which are more likely identified by their financial performance and operational risks.

Drawing on Chen (2015) [52], we constructed the Lerner Index (The calculation method of the Lerner Index is as follows: Lerner Index =(operating in-come- operating cost—selling expenses—administrative expenses) / operating income) to measure the competitive position of enterprises in the industry. The larger the ratio, the higher the competitive position and the stronger the pricing power of the enterprise in the industry. Table 9 shows that the estimated coefficient of Fintech is −0.3909 at the significance level of 1% in the high-competitive position group. This shows that Fintech has information advantages that recognize competitive enterprises in terms of future financial performance and default risk, which promote the concentration of credit resources in enterprises with high-competitive positions.

Table 9. Heterogeneity analysis: competitive positions of firms in the industry.

Variables	(1)	(2)
	Low-Competitive Position	High-Competitive Position
FINTECH_1	−0.5375	−0.3909 ***
	(0.4333)	(0.0719)
CVs	control	control
Observations	815	15,193
Adjusted R-squared	0.8980	0.9361
year FE	YES	YES
firm FE	YES	YES

Significance levels are indicated by *** for 1%.

Sample classification criteria: The corporation where the Lerner Index is greater than the median annual Lerner Index of all companies in the industry is divided into high-competitive position groups; conversely, it is defined as a low-competitive group.

5. Mechanism Test

To test the intermediary effects hypothesized above, this study follows the three-step process used in previous studies [53]. Tables 10 and 11 illustrate all the models associated with the three steps and use the intermediary effect model to verify the mechanism path of Fintech to ease corporate financing constraints.

5.1. Information Effect

Table 10 examines the "Fintech—information asymmetry—financing constraint" mechanism, and the results of columns (1) and (2) show that Fintech relies on optimized risk control technology. The advantages of collecting enterprise big data reduce the information asymmetry between the supply and demand of funds and alleviate enterprises' financing constraints. The estimated coefficient of the information asymmetry in column (3) is 0.0270 and passed the 1% significance test, indicating that the greater the degree of internal and external information asymmetry of the enterprise, the higher the degree of financing constraint of the enterprise; conversely, reducing the degree of information asymmetry has become one of the effective ways to alleviate the financing constraint of the enterprise. In addition, the estimated coefficient of Fintech is significantly negative at the statistical level

of 1% (coefficient of −0.5429), which further shows that Fintech has played an "information effect" by reducing the degree of information asymmetry and alleviating the dilemma of corporate financing constraints. Therefore, Fintech reduces information asymmetry and increases the financial institutions' ability to distinguish enterprises' financial information through corporate reputation, information flow, capital flow and other signals. H_2 is supported.

Table 10. Mechanism test: information effect.

Variables	(1)	(2)	(3)
	ASY	SAindex	SAindex
ASY			0.0270 ***
			(0.0050)
FINTECH_1	−0.4077 ***	−0.5459 ***	−0.5429 ***
	(0.1460)	(0.0850)	(0.0852)
CVs	control	control	control
Observations	16,143	16,282	16,143
Adjusted R-squared	0.6425	0.9307	0.9307
Year FE	YES	YES	YES
firm FE	YES	YES	YES

Significance levels are indicated by *** for 1%.

Table 11. Mechanism test: cost effect.

Variables	Panel A: Financial Costs			Panel B: Leverage	
	(1)	(2)	(3)	(4)	(5)
	SAindex	FE	SAindex	Leverage	SAindex
FINTECH_1	−0.5459 ***	−0.0198 *	−0.5322 ***	−0.0755 ***	−0.4536 ***
	(0.0850)	(0.0112)	(0.0852)	(0.0192)	(0.0817)
FE			0.2854 ***		
			(0.0659)		
Leverage					1.2223 ***
					(0.0365)
CVs	control	control	control	control	control
Observations	16,282	16,206	16,206	16,282	16,282
Adjusted R-squared	0.9307	0.4355	0.9307	0.8169	0.9360
Year FE	YES	YES	YES	YES	YES
firm FE	YES	YES	YES	YES	YES

Significance levels are indicated by *, *** for 5%, 1%.

5.2. Cost Effect

Table 11 examines the mechanism of "Fintech—financial cost (leverage level)—corporate financing constraint". Panel A in Table 10 examines the transmission path of "Fintech—financial cost—corporate financing constraint". The results of columns (1) and (2) show that Fintech reduces corporate financial costs (FE) and that Fintech has increased funds availability, causing a "resource effect". Significantly, column (3) is the key part. The estimated coefficient is 0.2854 and has passed the 1% significance test, indicating that the enterprise's high financial cost aggravates enterprise's financing constraints. In addition, the regression coefficient of Fintech is significantly negative at the statistical level of 1% (coefficient is −0.5322), which confirms that Fintech further mitigates corporate financing constraints by reducing corporate financing costs.

Panel B in Table 11 reports the intermediary effect results of "Fintech—leverage level—corporate financing constraints", and the results in column (4) show that the estimated coefficient of Fintech is −0.0755 and passes the 1% significance test. Columns (5) is the key concern, and the estimated coefficient of the enterprise's leverage level is positive at the significance level of 1%, which confirms that the high leverage level undoubtedly led the

enterprise to face financing difficulties; the estimated coefficient of Fintech for enterprise leverage is −0.4536, which is significant at the 1% significance level, showing a strong effect of reducing leverage. This means that Fintech has restrained enterprises from obtaining financial resources through aggressive leverage, which has greatly improved the allocation efficiency of financial resources and is conducive to the realization of the goal of reducing leverage and easing financing constraints for enterprises. Hypothesis 3 is demonstrated.

6. Further Discussion: The Impact of Fintech on the Corporate Financing Types

The existing research only studies Fintech providing financial support for enterprises. The further question worth asking pertains to which financing methods of enterprises, bank loans and commercial credit alleviate the enterprises' financing problems. In order to answer this question, this paper constructs the following empirical strategies to identify. In Formula (2), Type means the type of enterprise financing, which is specifically divided into commercial credit (NTC) and bank loan level (Loan), to verify the way Fintech works on two types of debt financing, such as bank loans and commercial credit obtained by enterprises; Formula (3) explores the interactive relationship between the development of Fintech, commercial credit and bank loans by constructing an interactive item between Fintech and bank loans (Loan). This paper uses (accounts payable + notes payable)/liabilities to measure the business credit (NTC) obtained by enterprises from business partners, and (short-term loans + long-term loans)/gross operating income to measure the level of bank loans (Loan) of enterprises, and conducts a 1% tail off treatment to avoid regression bias caused by extreme values. The identification strategy is as follows:

$$\mathrm{Type}_{ijt} = \alpha_0 + \delta_1 \mathrm{fintech}_{ijt} + \sum \gamma CV_{ijt} + year + u + \mu_{ijt} \quad (2)$$

$$\mathrm{NTC}_{ijt} = \alpha_0 + \beta_1 \mathrm{fintech}_{ijt} + \beta_2 \mathrm{fintech}_{ijt} \times \mathrm{Loan}_{ijt} + \beta_3 \mathrm{Loan}_{ijt} + \sum \varphi CV_{ijt} + year + u + \varepsilon_{ijt} \quad (3)$$

The alternative financing theory holds that in the case of credit rationing, some borrowers with a strong ability to pay interest on loans may not be able to obtain the bank loans required for business activities, and enterprises turn to business partners to obtain funds, so the existence of credit rations makes commercial credit an important alternative to bank loans [54].

The internal control level of enterprises is closely related to commercial credit financing. Table 12 takes whether the type of internal control defects of non-financial listed companies is 0 (When the internal control defect type = 0, it means there is no internal control defect; when the internal control defect type $\neq$ 0, it means there is an internal control defect, including: 1 = major defect; 2 = important defect; 3 = general defect) as the classification basis. The samples are divided into two groups: internal control defects and internal control defects. The estimated coefficients of FINTECH_1 in columns (1) and (3) are significant, showing that Fintech has a positive impact on enterprises' access to bank loans and commercial credit. Fintech will help enterprises without internal control defects to obtain commercial credit and bank loans, but it is not significant for enterprises with internal control defects.

Columns (5) and (6) in Table 12 examined the interaction between the development of Fintech, commercial credit and bank loans. In the group without internal control defects (5), the commercial credit obtained by enterprises increased significantly (the estimated coefficient of FINTECH_1 is 0.0840, which is significantly positive at the 1% significance level), and the amount of bank loans obtained decreased significantly (the estimated coefficient of loan is −0.1471, which is significantly negative at the 1% significance level), At this time, the substitution effect of business credit and bank loans of enterprises is significant (the coefficient of FINTECH_1*loan is 0.0108, which is significantly positive at the 5% significance level), indicating that the Fintech has promoted enterprises to use more business credit to obtain funds and reduced the use of bank loans to alleviate financing difficulties. However, in the group with internal control defects (6), the above conclusions are not significant.

Table 12. Impact of Fintech on the types of corporate finance.

Variables	Bank Loans (loan)		Business Credit (NTC)		Business Credit (NTC)	
	(1)	(2)	(3)	(4)	(5)	(6)
	No Internal Control Defects	Internal Control Deficiencies	No Internal Control Defects	Internal Control Deficiencies	No Internal Control Defects	Internal Control Deficiencies
FINTECH_1*loan					0.0108 **	−0.0046
					(0.0054)	(0.0104)
FINTECH_1	0.1464 *	−0.2495	0.0607 **	0.0074	0.0840 ***	−0.0040
	(0.0822)	(0.2217)	(0.0276)	(0.0493)	(0.0276)	(0.0485)
loan					−0.1471 ***	−0.0151
					(0.0274)	(0.0537)
Mshare	−0.0511	0.2145	0.0710 ***	0.1350 ***	0.0662 ***	0.1379 ***
	(0.0541)	(0.2109)	(0.0182)	(0.0447)	(0.0195)	(0.0476)
CF	−0.7237 ***	−0.5290 ***	0.0794 ***	0.0744 **	0.0144	0.1322 ***
	(0.0609)	(0.1426)	(0.0212)	(0.0329)	(0.0210)	(0.0336)
Top1	0.0011	0.0001	0.0004 *	−0.0004	0.0001	−0.0006 *
	(0.0007)	(0.0015)	(0.0002)	(0.0003)	(0.0002)	(0.0003)
ROA	−1.8588 ***	−2.0670 ***	0.2996 ***	0.1473 ***	0.1046 ***	0.0647
	(0.0974)	(0.2000)	(0.0329)	(0.0469)	(0.0342)	(0.0506)
TobinQ	−0.0201 ***	−0.0104	−0.0016	−0.0002	−0.0046 ***	−0.0035
	(0.0031)	(0.0097)	(0.0011)	(0.0022)	(0.0011)	(0.0023)
agdp	−0.0107 ***	−0.0200 **	−0.0041 ***	0.0038 *	−0.0051 ***	0.0016
	(0.0034)	(0.0096)	(0.0011)	(0.0022)	(0.0012)	(0.0022)
fd	0.0039 ***	0.0009	0.0001	−0.0005	0.0006	−0.0001
	(0.0011)	(0.0027)	(0.0004)	(0.0006)	(0.0004)	(0.0006)
fdi	0.0258	0.3733	0.0188	0.1019	0.1185	0.1268
	(0.1957)	(0.3688)	(0.0678)	(0.0878)	(0.0723)	(0.0898)
Observations	9752	2745	9813	2664	8815	2297
Adjusted R-squared	0.7261	0.7255	0.7699	0.8695	0.7953	0.8766
Year FE	YES	YES	YES	YES	YES	YES
firm FE	YES	YES	YES	YES	YES	YES

Significance levels are indicated by *, **, *** for 10%, 5%, and 1%.

7. Conclusions and Discussion

7.1. Conclusions

On the basis of clarifying the relevant theoretical mechanisms of Fintech and corporate financing constraints, this paper empirically tests the logical relationship and micro mechanism between Fintech and the corporate financing constraints using the data of Chinese A-share listed companies from 2011 to 2018 as research samples.

Firstly, as mentioned earlier, especially in developing economies such as China, the relationship between Fintech and traditional financial systems can be complicated. The conclusion of the article shows that Fintech can relieve corporate financing constraints, which is still valid after further robustness tests.

Secondly, we also examined intermediary effects. The mechanism research shows that Fintech "enabling" financial institutions achieve the purpose of easing corporate financing constraints by reducing the information asymmetry between the funds' supply and demand and by reducing financing cost.

Furthermore, this paper analyzes the heterogeneity factors such as regional attributes, senior executives' financial background, property rights attributes, stock market segment and competitive status of enterprises in the industry, and finds that the mitigation effect of Fintech on corporate financing constraints is more significant in eastern regions, senior executives with high financial literacy, private enterprises, non-main-board-listed enterprises, and enterprises with high competitive status.

Finally, considering the Fintech' impact on the types of enterprise financing, it is observed that enterprises facing financing constraints tend to get more commercial credit and bank loans under the condition of higher internal control quality, but not significantly among enterprises with lower internal control quality. When enterprises are faced with credit rationing, or when it is difficult to obtain bank loans, commercial credit has become an alternative financing method for bank loans, promoting the transfer of credit resources from traditional mortgage guarantees to enterprise commercial credit.

7.2. Limitations

However, this research has some limitations. First, we used the data of listed companies to analyze the financing constraints. However, the financing constraints may also exist in non-listed companies, so we should expand the research perspective to non-listed companies in the future to verify the robustness of the research conclusions. Second, the sample in this study was from one single country, and future studies could extend the study to more countries, especially developing countries. Finally, the enterprise financing constraints were not only due to the problems of the existing financial system, so the existing model can incorporate other exogenous variables (such as enterprise project risk, industry type and accounting system).

Author Contributions: Conceptualization Z.J. and Y.L.; methodology, Y.L.; software, Y.L.; formal analysis, Z.J.; resources, Y.L. and Z.Z.; data curation, Z.Z.; writing—original draft preparation, Y.L.; writing—review and editing, Y.L., Z.J. and X.Z.; supervision, X.Z.; project administration, Z.J. and X.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Publicly available datasets were analyzed in this study. The data are obtained from "China City Statistical Yearbook", Shanghai and Shenzhen Stock Exchanges, CSMAR data platform, Digital Finance Research Center of Peking University.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Huang, Y.; Huang, Z. China's digital finance development: Present and future. *China Econ. Q.* **2018**, *17*, 1489–1502.
2. Gomber, P.; Kauffman, R.J.; Parker, C.; Weber, B.W. On the Fintech revolution: Interpreting the forces of innovation, disruption and transformation in financial services. *J. Manag. Inf. Syst.* **2018**, *35*, 220–265. [CrossRef]
3. Zhu, C. Big data as a governance mechanism. *Rev. Financ. Stud.* **2019**, *32*, 2021–2061. [CrossRef]
4. Fuster, A.; Plosser, M.; Schnabl, P.; Vickery, J. The role of technology in mortgage lending. *Rev. Financ. Stud.* **2019**, *32*, 1854–1899. [CrossRef]
5. Kowalewski, O.; Pisany, P. Banks' consumer lending reaction to fintech and bigtech credit emergence in the context of soft versus hard credit information processing. *Int. Rev. Financ. Anal.* **2022**, *81*, 102116. [CrossRef]
6. Nguyen, Q.K. The Effect of FinTech Development on Financial Stability in an Emerging Market: The Role of Market Discipline. *Res. Glob.* **2022**, *5*, 100–105.
7. Fazzari, S.M.; Hubbard, R.G.; Petersen, B.C. Financing Constraints and Corporate Investment. *Brook. Pap. Econ. Act.* **1988**, *1988*, 141–195. [CrossRef]
8. Yosepha, S.Y. The Role of Fintech Encourages the Export of Small Medium Enterprises in Indonesia. *J. Soc. Dev. Sci.* **2018**, *9*, 66–77.
9. Xie, X.; Shen, Y.; Zhang, H.; Guo, F. Can Fintech promote entrepreneurship—Evidence from China. *China Econ. Q.* **2018**, *17*, 1557–1580.
10. Zhang, X.; Li, Z.; Li, C. Banking Competition, Financing Constraints and Enterprise Innovation—Empirical Evidence of Chinese Industrial Enterprises. *Financ. Res.* **2019**, *10*, 98–116.
11. Beck, T.; Demirguec-Kunt, A.; Maksimovic, V. Financial and legal constraints to growth: Does firm size matter. *J. Financ.* **2005**, *60*, 137–177. [CrossRef]
12. Huang, R.; Lai, X.; Tang, S. How does Fintech affect corporate financing constraints—Dynamic effects, heterogeneity characteristics and macro—And micro—Mechanism tests. *Int. Financ. Res.* **2020**, *398*, 25–33.
13. Stiglitz, J.E.; Weiss, A. Credit Rationing in Markets with Imperfect Information. *Am. Econ. Rev.* **1981**, *71*, 393–410.

14. Cull, R.; Xu, L.C. Who gets credit? The behavior of bureaucrats and state banks in allocating credit to Chinese state-owned enterprises. *J. Dev. Econ.* **2003**, *71*, 533–559. [CrossRef]
15. Lu, F.; Yao, Y. The rule of law, financial development and economic growth under financial repression. *Chin. Soc. Sci.* **2004**, *1*, 42–55.
16. Tang, S.; Lai, X.; Huang, R. How Fintech innovations affect total factor productivity: Promote or inhibit?—Theoretical analysis framework and regional practice. *Chin. Soft. Sci.* **2019**, 134–144.
17. Xie, X.; Zhu, X. Fintech and SME Technology Innovation—Evidence from NEEQ Enterprises. *Int. Financ. Stud.* **2021**, *1*, 87–96.
18. Sutherland, A. Does credit reporting lead to a decline in relationship lending? Evidence from information sharing technology. *J. Account. Econ.* **2018**, *66*, 123–141. [CrossRef]
19. Bruce, G.; Stiglitz, J.; White, A. Information imperfections and macroeconomic fluctuations. *Am. Econ. Rev.* **1984**, *74*, 194–199.
20. Myers, S.C.; Majluf, N.S. Corporate financing and investment decisions when firms have information that investors do not have. *J. Financ. Econ.* **1984**, *13*, 187–221. [CrossRef]
21. Erel, I.; Jang, Y.; Weisbach, M.S. Do Acquisitions Relieve Target Firms Financial Constraints? *J. Financ.* **2015**, *70*, 289–328. [CrossRef]
22. Shaffer, S. The Winner's Curse in Banking. *J. Financ. Intermediation* **1998**, *7*, 359–392. [CrossRef]
23. Limit, R.G. Insiders and Outsiders: The Choice Between Informed and Arm's-length Debt. *J. Financ.* **1992**, *47*, 1367–1400.
24. Diamond, D.W. Financial Intermediation and Delegated Monitoring. *Rev. Econ. Stud.* **1984**, *51*, 393–414. [CrossRef]
25. Demertzis, M.; Merler, S.; Wolff, G.B. Capital markets union and the Fintech opportunity. *J. Financ. Regul.* **2018**, *4*, 157–165. [CrossRef]
26. Du, Y.; Zhang, H.; Chen, J. The impact of financialization on the future development of the main business of real enterprises:Promote or inhibit. *China's Ind. Econ.* **2017**, *12*, 113–131.
27. Banker, R.D.; Byzalov, D.; Ciftci, M.; Mashruwala, R. The Moderating Effect of Prior Sales Changes on Asymmetric Cost Behavior. *J. Manag. Account. Res.* **2014**, *26*, 43–79. [CrossRef]
28. Beck, T.; Pamuk, H.; Ramrattan, R.; Uras, B.R. Payment instruments, finance and development. *J. Dev. Econ.* **2018**, *133*, 162–186. [CrossRef]
29. Luo, S.; Sun, Y.; Zhou, R. Can fintech innovation promote household consumption? Evidence from China family panel studies. *Int. Rev. Financ. Anal.* **2022**, *82*, 102–137. [CrossRef]
30. Yi, X.; Zhou, L. Whether the Fintech has significantly affected household consumption micro-evidence from Chinese households. *Financ. Stud.* **2018**, *11*, 47–67.
31. Thakor, A.V. Fintech and banking: What do we know? *J. Financ. Intermediation* **2020**, *41*, 100833. [CrossRef]
32. Joe-Wong, C.; Sen, S. Harnessing the Power of the Cloud: Revenue, Fairness, and Cloud Neutrality. *J. Manag. Inf. Syst.* **2018**, *35*, 813–836. [CrossRef]
33. Xie, P.; Liu, H. ICT, mobile payment and electronic money. *Financ. Stud.* **2013**, *10*, 1–14.
34. Ling, S.; Pei, T.; Li, Z.; Zhang, Z. Impact of COVID-19 on Financial Constraints and the Moderating Effect of Financial Technology. *Emerg. Mark. Financ. Trade* **2021**, *57*, 1675–1688. [CrossRef]
35. Easley, D.; Hara, M. Information and the Cost of Capital. *J. Financ.* **2004**, *59*, 1553–1583. [CrossRef]
36. Lamont, O.; Polk, C.; Saa'a-Requejo, J. Financial constraints and stock returns. *Rev. Financ. Stud.* **2001**, *14*, 529–554. [CrossRef]
37. Fee, C.E.; Hadlock, C.J.; Pierce, J.R. Investment, financing constraints, and internal capital markets: Evidence from the advertising expenditures of multinational firms. *Rev. Financ. Stud.* **2009**, *22*, 2361–2392. [CrossRef]
38. Whited, T.M.; Wu, G.J. Financial constraints risk. *Rev. Financ. Stud.* **2006**, *19*, 531–559. [CrossRef]
39. Hadlock, C.J.; Pierce, J.R. New Evidence on Measuring Financial Constraints: Moving Beyond the KZ Index. *Rev. Financ. Stud.* **2010**, *23*, 1909–1940. [CrossRef]
40. Kaplan, S.N.; Zingales, L. From the Investment—Cash Flow Sensitivities Provide Useful Measures of Financing Constraints. *Q. J. Econ.* **1997**, *112*, 169–215. [CrossRef]
41. Guo, F.; Wang, J.; Wang, F.; Kong, T.; Zhang, X.; Cheng, Z. Measuring China's digital inclusive financial development: Index compilation and spatial characteristics. *China Econ. Q.* **2020**, *19*, 1401–1418.
42. Huang, R.D.; Stoll, H.R. The components of the bid-ask spread: A general approach. *Rev. Financ. Stud.* **1997**, *10*, 995–1034. [CrossRef]
43. Brennan, M.; Huh, S.; Subrahmanyan, A. An analysis of the Amihud illiquidity premium. *Rev. Asset Pricing Stud.* **2013**, *3*, 133–176. [CrossRef]
44. Yu, W.; Wang, M.; Jin, X. Political connection and financing constraints: Information effect and resource effect. *Econ. Res.* **2012**, *9*, 125–139.
45. Minnis, M. Discussion of The Value of Financial Statement Verification in Debt Financing: Evidence from Private U.S. *Firms. J. Account. Res.* **2011**, *49*, 507–528.
46. Lu, Z.; Yang, D. Commercial credit: Alternative financing is still a buyer's market? *J. Manag. World* **2011**, *4*, 6–14.
47. Chen, M.J.; Guariglia, A. Internal financial constraints and firm productivity in China: Do liquidity and export behavior make a difference? *J. Comp. Econ.* **2013**, *41*, 1123–1140. [CrossRef]
48. Cincera, M.; Ravet, J. Financing constraints and R&D investments of large corporations in Europe and the US. *Sci. Public Policy* **2010**, *37*, 455–466.

49. Houston, J.F.; Lin, C.; Lin, P.; Ma, Y. Creditor rights, information sharing, and bank risk taking. *J. Financ. Econ.* **2010**, *96*, 485–512. [CrossRef]
50. Moser, P.; Voena, A. Compulsory Licensing: Evidence from the Trading With The Enemy Act. *Am. Econ. Rev.* **2012**, *102*, 396–427. [CrossRef]
51. Hambrick, D.C.; Mason, P.A. Upper Echelons. *Autom. Control Comput. Sci.* **1984**, *41*, 39–43.
52. Chen, Z.; Wang, S. Research on the impact of product market competition on the cash flow risk of enterprises—Based on the dual consideration of the degree of industry competition and the competitive position of enterprises. *China's Ind. Econ.* **2015**, *3*, 96–108.
53. Baron, R.M.; Kenny, D.A. The Moderator-Mediator variable distinction in social psychological research: Concept strategic and statistical considerations. *J. Personal. Soc. Psychol.* **1986**, *51*, 1173–1182. [CrossRef] [PubMed]
54. Petersen, M.A.; Rajan, R.G. Trade Credit: Theories and Evidence. *Rev. Financ. Stud.* **1997**, *10*, 661–691. [CrossRef]

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