

Supply Chain Finance, Fintech and SME Financing Constraints

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Abstract

The supply-side structural reform of financial service market is still hindered by the slow financing speed and high financing cost of SMEs, while the development of supply chain finance and financial technology provides new ideas to solve the financing constraint. Based on the data of 440 small and medium-sized listed companies in Shenzhen Stock Exchange, this paper verifies the prevalence of financing constraint of SMEs by using Cash-Cash Flow sensitivity model, after that establishes a regression model to explore whether the development of supply chain finance can alleviate the financing constraint of SMEs, and whether the development of financial technology can effectively regulate this alleviating effect, and conducts a heterogeneity test of regions and types of enterprises. The conclusions show that supply chain finance can alleviate the financing constraint faced by SMEs, and this alleviation effect is more significant after considering fintech.

Keywords

Supply Chain Finance; Fintech; Financing Constraints; Cash-Cash Flow Sensitivity Model.

1. Introduction

Chinese SMEs have an irreplaceable role in many social functions, such as providing employment opportunities, maintaining market dynamics, and promoting economic growth, but their small size, insufficient creditworthiness, and lack of collateral are also prominent disadvantages, which make financing difficult and expensive for SMEs. As early as 2013, the International Monetary Fund (IMF) found that the lack of capital was a key constraint to the development of SMEs through a study of low- and middle-income economies. Since Fazzari et al. (1988) began to study corporate financing constraints, many domestic and foreign scholars have also dissected the causes of SMEs' financing difficulties. From the aspect of financial institutions, compared with SMEs, large enterprises have more adequate information disclosure, and commercial banks often choose to raise the credit threshold and accept large enterprises with lower risk to avoid adverse selection and moral wind selection and force to withdraw from the credit market to SMEs. Cheng, Jing and Hu, Jinlin (2019) also point out that banks are more willing to lend funds to large enterprises to reduce bank risk. From the aspect of SMEs, banks will increase their lending rates when financing SMEs considering the higher risks they face, and SMEs that can hardly afford the high financing costs will give up financing and thus withdraw from the credit market, and there are many such SMEs. Xu Gaojie et al. (2020) argue that technology SMEs in the start-up stage have the problems of irregular management, poor financial management and their own financing ability.

Among the available research, scholars have studied various ways to alleviate the financing constraints of SMEs, and the following are five representative ways: (i) Financial system development: some scholars have studied the improvement of the financial system to broaden the external financing channels of SMEs and alleviate the financing constraints of SMEs (Beck et al., 2007). (ii) Digital finance: Huang Rui et al. (2021) argue that digital finance can improve the financing structure and market environment through the integration of underlying technology and financial innovation, and reduce the financing costs and risks of enterprises

through the advantages of technology, which can be beneficial to alleviate the financing constraints of enterprises (Huang Rui et al., 2021). (iii) Government industrial policy support: Some studies have found that industrial policy support (e.g., productive government subsidies) can be used to send favorable signals to external stakeholders, making it easier for enterprises to obtain financial support and thus alleviating financing pressure (Cui Haihong et al., 2021). (iv) Fintech: Some scholars have pointed out the important role of fintech in solving the financing problems of SMEs as well. Wang Xiangning et al. (2021) have found that fintech can influence financing constraints through the intermediary mechanism of information asymmetry. (v) Supply chain finance: In addition to the above four pathways, there are many studies that have been conducted from the pathway of supply chain finance to alleviate financing constraints.

With the development of financial technology, the Internet and big data technology are widely used in the financial field, promoting the development of supply chain finance. Berger et al. (2006) first measured small and micro enterprises as part of the supply chain system and proposed a loan model using supply chain financial services to finance micro enterprises. In recent years, China has attached great importance to the development of supply chain finance for SMEs, and the China Banking and Insurance Regulatory Commission issued the "Guidance on Promoting Supply Chain Financial Services for the Real Economy" in 2019, clearly stating that banking and other financial institutions should provide comprehensive financial services to their upstream and downstream chain enterprises based on the core supply chain enterprises, while in the 2020, People's Bank of China Industry and Information Ministry published a guidance, involving many supply chain finance regulation and innovation as well. It has promoted the development of supply chain amount in China.

Supply chain finance links banks, core enterprises and upstream and downstream enterprises through the management, organization, and coordination of core enterprises for mutual benefit and coexistence, breaking the limitation of single enterprise credit of traditional finance and relying on the credit of core enterprises to inject funds into upstream and downstream SMEs, which can relieve the financing difficulties of upstream and downstream SMEs to a certain extent. Scholars have explored different mechanisms of supply chain finance to alleviate the financing constraints of SMEs: (i) Zhang Weibin et al. (2012), based on the credit risk perspective, argue that supply chain finance complements the credit deficiency of SMEs through the information advantage of core large enterprises, which improves the credit level of SMEs and thus alleviates the financing constraints of SMEs. (ii) Chen et al. (2015) explained from the perspective of game theory that the introduction of supply chain finance would change the revenue function of banks and enterprises, which would increase the incentive of banks to lend, thus alleviating the financing constraints of SMEs. Some scholars have further investigated the difference in the intensity of this alleviating effect based on the verification that the development of supply chain finance has an alleviating effect on the financing constraints of SMEs. For example, Zhang Jian et al. (2019) argue that supply chain finance has a higher intensity of alleviating constraints for guarantors of related transactions; Yan Hongguo et al. (2020) point out that this alleviating effect is more significant for companies with higher concentration in the supply chain.

The above analysis reveals that SMEs have financing constraints in theory, but much of the literature starts from theoretical analysis. In addition, studies have analyzed the effect of mitigation of financing constraints on SMEs in multiple ways, but among them, the study of the impact mechanism of supply chain finance to mitigate corporate financing constraints is inconsistent, and there is little quantitative analysis on the relationship between the development of fintech and financing constraints of SMEs. Therefore, this paper verifies at the empirical level whether SMEs have a financing constraint problem? Can supply chain finance significantly alleviate the financing constraint of SMEs? Does the level of fintech development

have a moderating effect on supply chain finance to alleviate the financing constraints of SMEs? Is there heterogeneity in the impact of supply chain finance on financing constraints and the moderating effect of fintech at the regional as well as firm type level?

The rest parts are set as follows: section 2 represents theoretical analysis and hypothesis formulation; the empirical model is set up in section 3; the results of the empirical method are detailed in section 4, including checks of heterogeneity and robustness; section 5 concludes.

2. Theoretical Analysis and Hypothesis Formulation

2.1. Current Situation of Financing Constraints of SMEs

Generally, Financing constraints are caused by information asymmetry and agency problems, and the cost of external financing is higher than that of internal financing. Due to the limitation of asset size, many SMEs can hardly support their operation by internal financing alone, so they urgently need external financing, and the main source of external financing is banks, and the following reasons can restrict SMEs from financing through external channels.

There is a serious information asymmetry problem for SMEs in financing. Due to the inadequate corporate governance of SMEs and the lack of a sound information disclosure system and a standardized financial system, it is difficult to obtain true information about the enterprises and to evaluate their operation and management capabilities. Too much unavailable private information makes information asymmetry exist between SMEs and banks, and banks have to set up more external supervision measures in order to reduce potential moral hazard, which raises the cost of external financing for SMEs.

SMEs have higher moral hazard and agency cost in financing. Since SMEs operate on a small scale and their debts are mostly current liabilities and intangible assets, they lack eligible pledges and do not meet the standard credit pledge guarantee requirements. As a supplier of funds, banks are naturally reluctant to actively provide loans to SMEs for security reasons.

High instability of SMEs. SMEs are susceptible to changes in the market environment, and their loan needs generally require high liquidity, and the small amount and high frequency of loans compared to those of large enterprises can impose significant information gathering and supervision costs on banks, thus lacking incentives to provide loans to SMEs.

Based on the above analysis, one of the research hypotheses of this paper is proposed:

H1: Chinese listed SMEs have a financing constraint problem.

2.2. Supply Chain Finance to Alleviate Financing Constraints

As an emerging financing method for enterprises, supply chain finance can help alleviate financing constraints from the following perspectives.

From the perspective of financing eligibility, credit scale is mostly tilted to enterprises with high credit level and large asset scale. SMEs are often rejected by financial institutions providing financing due to the limitations of credit rating and asset scale. By using supply chain finance, SMEs can obtain financing funds through supply chain channels with the credit guarantee of core enterprises and the advantage of their information resources. In addition, supply chain finance uses third-party logistics to act as a medium between financial intermediaries and SMEs, which can also improve the transparency of information of SMEs and alleviate the financing difficulties caused by information asymmetry. Therefore, the financing opportunities of SMEs through supply chain finance are greatly improved.

From the perspective of financing cost, the supply chain unites raw material suppliers, producers, distributors, end consumers, and financial institutions that enter through capital supply, bank credit and financial services, forming a one-stop integrated supply chain service. A more solid credit model can be formed between banks and enterprises, and using a fixed

operating path and environment, banks' operating costs can be significantly reduced and approval efficiency can be effectively improved. In addition, as mentioned earlier, banks add additional supervision costs due to information asymmetry and agency problems, but with supply chain finance, banks can make a complete credit risk assessment of the entire supply chain and thus develop the right financing solution. Therefore, the financing cost of SMEs can be effectively decreased through supply chain finance.

Based on the above analysis, the article proposes the hypothesis that:

H2: Supply chain finance can significantly alleviate the financing constraints of SMEs.

2.3. Supply Chain Finance, Financial Technology, and Financing Constraints

As mentioned above, supply chain finance can help alleviate the financing constraints of SMEs from the perspective of financing eligibility and financing cost, while adding fintech to supply chain finance can provide new ideas for SMEs to get out of the financing dilemma. In the context of the development of financial technology, supply chain finance can further innovate based on the traditional model, thus further helping to solve the problem of financing difficulties of SMEs.

From the perspective of financing cost, with the development of fintech, using big data, cloud computing and blockchain technology, the database of enterprises in the whole supply chain can be established to provide banks with real and effective enterprise information, thus improving the information transparency of SMEs, banks can also better carry out credit collection and credit rating, the information asymmetry between banks and enterprises can be alleviated, and the cost of establishing trust between the two sides is reduced.

From the perspective of financing efficiency, fintech is used to realize the electronic operation process, thus simplifying and accelerating the procedures of loan approval, verification and issuance, reducing the labor intensity and hierarchical relationship in the lending process; providing services such as accurate customer acquisition, screening, pushing and integration of lending, performance information and post-loan management, platforming core enterprises, enriching credit supply methods and efficient information acquisition, thus improving the financing efficiency.

Based on the above analysis, the article proposes the hypothesis that:

H3: Fintech can effectively regulate the alleviation effect of supply chain finance on enterprise financing constraints.

3. Study Design

3.1. Sample Selection and Data Processing

The data used in this paper are obtained from the CSMAR database. The initial sample is selected from all SMEs listed on the main board of the Shenzhen Stock Exchange (stock code 002) from 2014 to 2018, and in order to avoid the influence of unnecessary "noise" on the empirical results, the following screenings are conducted: (1) The listed companies with incomplete indicators and incomplete data are excluded; (2) In order to get more accurate corporate financial data and avoid the interference of various indicators due to poor business operation, companies with ST and ST* are excluded; (3) In order to eliminate the influence of extreme values on the empirical analysis, all continuous variables are winsorized by 1% up and down in this paper. Finally, 440 listed companies are obtained as observation samples, with a total of 2220 sample observations.

3.2. Research Methodology and Model Construction

This paper selects the Cash-Cash Flow sensitivity model (CCF) proposed by Almeida et al. (2004) and others to measure the financing constraint of the firm. This model shows that the financing constraint is positively related to the external financing cost of an enterprise, and the higher

the financing constraint is, the more difficult it is for an enterprise to obtain funds through traditional financing channels, and the more likely it is to choose to take out investment funds from its own cash flow, thus generating cash-cash flow sensitivity. To test hypothesis H1, this paper draws on the study of Huifeng Jiang et al. (2021) to construct a benchmark model for measuring financing constraints as shown in equation (1):

$$\Delta\text{CASH}_{i,t} = \alpha_0 + \alpha_1\text{CF}_{i,t} + \alpha_2\text{SZ}_{i,t} + \alpha_3\text{RI}_{i,t} + \alpha_4\text{GRO}_{i,t} + \alpha_5\Delta\text{NWC}_{i,t} + \alpha_6\Delta\text{CE}_{i,t} + \sum\text{Year} + \sum\text{Industry} + \varepsilon_{i,t} \quad (1)$$

Where, i denotes the firm, t denotes the year, the explanatory variable $\Delta\text{CASH}_{i,t}$ is the change in cash holdings, the core explanatory variable $\text{CF}_{i,t}$ is the firm's operating cash flow, and its regression coefficient α_1 indicates sensitivity between cash flow and cash holdings when it is positive. $\text{SZ}_{i,t}$, $\text{RI}_{i,t}$, $\text{GRO}_{i,t}$, $\Delta\text{NWC}_{i,t}$, $\Delta\text{CE}_{i,t}$ are control variables, $\sum\text{Year}$ is a year dummy variable, and $\sum\text{Industry}$ is an industry dummy variable, $\varepsilon_{i,t}$ is an error disturbance term.

To test H2, the supply chain finance model (2) is obtained by adding the degree of supply chain finance development (SCF), the cross product term of supply chain finance and operating cash flow ($\text{SCF} \times \text{CF}$) to the basic model (1), when the regression coefficient α_3 is negative, it proves that supply chain finance can alleviate enterprise financing constraints.

$$\Delta\text{CASH}_{i,t} = \alpha_0 + \alpha_1\text{CF}_{i,t} + \alpha_2\text{SCF}_{i,t} + \alpha_3\text{SCF}_{i,t} \times \text{CF}_{i,t} + \alpha_4\text{SZ}_{i,t} + \alpha_5\text{RI}_{i,t} + \alpha_6\text{GRO}_{i,t} + \alpha_7\Delta\text{NWC}_{i,t} + \alpha_8\Delta\text{CE}_{i,t} + \sum\text{Year} + \sum\text{Industry} + \varepsilon_{i,t} \quad (2)$$

To further investigate the moderating constraint of the degree of fintech development in the impact of supply chain finance on financing constraints, model (3) is constructed.

$$\Delta\text{CASH}_{i,t} = \alpha_0 + \alpha_1\text{CF}_{i,t} + \alpha_2\text{SCF}_{i,t} + \beta_1\text{Infintech}_{i,t} \times \text{SCF}_{i,t} \times \text{CF}_{i,t} + \alpha_4\text{SZ}_{i,t} + \alpha_5\text{RI}_{i,t} + \alpha_6\text{GRO}_{i,t} + \alpha_7\Delta\text{NWC}_{i,t} + \alpha_8\Delta\text{CE}_{i,t} + \sum\text{Year} + \sum\text{Industry} + \varepsilon_{i,t} \quad (3)$$

Where, $\text{Infintech}_{i,t}$ denotes the level of fintech development in the city where listed company i is registered. When the core parameter to be estimated β_1 is negative, it indicates that the fintech development plays a moderating role.

3.3. Setting of Main Variables

1) Financing constraint. Draw on the Cash-Cash Flow sensitivity model (CCF) proposed by Almeida et al. (2004) and others to measure the financing constraint of firms.

2) Supply chain finance. Referring to the indicators from Yao Wangxin et al. (2017) to measure supply chain finance indicators, the sum of short-term borrowing and bills payable is used to quantify the level of supply chain finance.

3) The level of financial technology development. Referring to the measurement method of Song Min et al. (2021), using the big data of national industrial and commercial enterprise registration, the business operations of enterprises are identified through text analysis, including "financial technology", "cloud computing", "big data", "blockchain", "artificial intelligence", "Internet of things" and other keywords, in order to obtain the business registration information of all related companies. At the same time, the sample of companies with less than 1 year of operation or irregular operation status (such as defunct, dissolved, suspended, etc.) were excluded to prevent the registration of "shell companies". Finally, the level of fintech development in the proxy area is obtained by summing up and taking the natural logarithm at the city level.

4) Other variables. Other variables are defined in Table 1.

Table 1. Variable descriptions

Variable Type	Variable Symbol	Variable Name	Variable Definition
Explanatory variable	$\Delta\text{CASH}_{i,t}$	Change in cash holdings	Net increase in cash and cash equivalents in year t / total assets at the end of year t
Core explanatory variables	$\text{CF}_{i,t}$	Operating Cash Flow	Net cash generated from operating activities in year t / Total assets at the end of year t
	$\text{SCF}_{i,t}$	Degree of Supply Chain Development	(Short-term loans in year t + notes payable in year t) / Total assets of the company at the end of year t
	Infintech	Fintech Development	Natural logarithm of the number of fintech-related companies in the city
Enterprise control variables	$\text{SZ}_{i,t}$	Enterprise size	Natural logarithm of the company's total assets at the end of year t
	$\text{RI}_{i,t}$	Gearing ratio	Total liabilities of the company at the end of year t / Total assets of the company at the end of year t
	$\text{GRO}_{i,t}$	Operating Income Growth Rate	[Operating income in year t - (t-1) operating income in year t] / (t-1) operating income in year t
	$\Delta\text{NWC}_{i,t}$	Change in net working capital	[Net working capital in year t - net working capital in (t-1)] / Total assets at the end of year t
	$\Delta\text{CE}_{i,t}$	Change in capital expenditure	[Capital expenditures in year t - (t-1) capital expenditures in year t] / Total assets at the end of year t

4. Empirical Results and Analysis

4.1. Basic Analysis

1) Descriptive statistics

The results are shown in Table 2. It can be seen that the difference between the maximum value and the minimum value of ΔCASH of listed small and medium-sized companies is large, which indicates that the variation of cash holding ratio of companies is significant, but the standard deviation is 0.073, that is, the variation of cash holding between companies is small. The mean value of CF is 0.04 and the standard deviation is 0.06, which also shows the characteristic of "small mean value and large standard error", indicating that there are differences in the operating cash flows of companies, but the differences are not obvious; the mean value of SCF indicator is 0.173, the maximum value is 0.512, the minimum value is 0.004, and the standard deviation is 0.114, indicating that there are obvious differences in the degree of supply chain development of listed SMEs; the mean value of Infintech is 3.855, with a standard deviation of 2.408, indicating that the level of fintech development in the cities where different companies are located has a large difference. In terms of control variables, there are also significant differences between firms in terms of firm size (SZ), gearing ratio (RI), growth rate of operating income (GRO), change in net working capital (ΔNWC), and change in capital expenditure (ΔCE).

Table 2. Descriptive statistics of main variables

	Variable	Number of observations	Mean	Standard deviation	Minimum	Maximum
Explained variables	$\Delta CASH_{i,t}$	2220	0.010	0.073	-0.197	0.311
Core explanatory variables	$CF_{i,t}$	2220	0.040	0.060	-0.149	0.213
	$SCF_{i,t}$	2220	0.173	0.114	0.004	0.512
	$Infintech_{i,t}$	2220	3.855	2.408	0	10.094
Firm control variables	$SZ_{i,t}$	2220	22.250	0.892	20.464	24.794
	$RI_{i,t}$	2220	0.442	0.168	0.109	0.827
	$GRO_{i,t}$	2220	0.212	0.391	-0.429	2.428
	$\Delta NWC_{i,t}$	2220	0.013	0.109	-0.266	0.372
	$\Delta CE_{i,t}$	2220	0.004	0.035	-0.094	0.139

2) Correlation analysis

Table 3 shows the correlation coefficients among the variables, and it can be seen from the table that the largest absolute value of correlation coefficient among the variables is 0.583, so there is no problem of multicollinearity. The change in cash holdings is significantly correlated with operating cash holdings and the degree of supply chain development at 1% and 10% levels, respectively, and shows a negative correlation with SCF, which tentatively proves that the development of supply chain finance has a certain alleviating effect on financing constraints.

Table 3. Correlation analysis of variables

	CASH	CF	SCF	Infintech	SZ	RI	GRO
CASH	1						
CF	0.127***	1					
SCF	-0.038*	-0.134***	1				
Infintech	-0.009	-0.102***	-0.018	1			
SZ	0.064***	-0.048**	0.066***	0.138***	1		
RI	-0.043**	-0.162***	0.583***	0.105***	0.441***	1	
GRO	0.128***	-0.023	-0.047**	0.018	0.171***	0.00300	1
ΔNWC	0.534***	-0.002	-0.210***	0.002	0.035*	-0.223***	0.172***
ΔCE	0.046**	0.059***	-0.017	0.016	0.121***	0.0100	0.151***
	ΔNWC	ΔCE					
ΔNWC	1						
ΔCE	-0.017	1					

Note: The values in the first row of the table indicate the parameter estimation results, and the values in the second row in parentheses are t-statistics; ***, **, *, etc. represent significant at the 1%, 5%, and 10% levels, respectively.

4.2. Analysis of Regression Results

1) Impact of supply chain finance on corporate financing constraints

Table 4 reports the regression results with Cash-Cash Flow sensitivity as the test model. From the results in column (1) of the model, the amount of change in cash holdings and operating cash flow are significantly positively correlated at the 1% significance level, with a regression coefficient of 0.246, indicating that there is sensitivity between corporate cash flow and cash holdings, and an increase in cash flow by one unit increases corporate cash holdings by an

average of 0.246 units, basically verifying that listed SMEs in China are generally subject to financing constraints. The assertion that SMEs have the problem of financing information asymmetry and poor financing channels may be due to the lack of capital market development in China. The column of model (2) in Table 4 demonstrates the impact of supply chain finance development on financing constraints. It can be seen that the impact coefficient of cash flow increases after adding the variables related to supply chain finance again, which may be due to the problem of omitted variables in the benchmark model, resulting in the regression coefficient measured in model (1) being smaller than the actual value, and the impact coefficient increases after adding the omitted variables but is smaller compared to the original actual value. In addition, supply chain finance is significantly positively correlated with cash holdings at the 1% level, with an impact coefficient of 0.192, indicating that there is a significant financing constraint while enterprises develop supply chain finance.

2) The moderating effect of fintech development

Table 4. Regression results of models (1), (2) and (3)

Variables	Model(1)	Model(2)	Model(3)
CF	0.246***	0.341***	0.331***
	(8.05)	(6.47)	(7.69)
SCF		0.192***	0.185***
		(6.06)	(5.87)
CF_SCF		-0.386*	
		(-1.69)	
CF_SCF_Infintech			-0.093**
			(-2.20)
SZ	0.018***	0.024***	0.024***
	(3.41)	(4.45)	(4.36)
RI	0.155***	0.081***	0.078***
	(7.82)	(3.44)	(3.26)
GRO	-0.003	-0.003	-0.002
	(-0.77)	(-0.67)	(-0.54)
Δ NWC	0.402***	0.410***	0.405***
	(27.75)	(28.45)	(27.75)
Δ CE	0.063	0.072*	0.058
	(1.52)	(1.74)	(1.39)
Time Effect	Yes	Yes	Yes
Industry Effect	Yes	Yes	Yes
N	2,020	2,020	2,020
R-squared	0.346	0.360	0.354

4.3. Heterogeneity Analysis

Due to the different resource endowments and development status of each region, the development of fintech and supply chain finance are regionally heterogeneous, and there are differences in the financing constraints faced by different types of enterprises, for example, state-owned enterprises are larger and stronger than private enterprises, and are more likely to obtain financing.

4.4. Regional Heterogeneity

The article divides the full sample into two subsamples based on regional characteristics: the eastern region has a total of 1700 samples and the non-eastern region has a total of 500 samples. From the regression results in Table 5, in the whole region, both free cash flow and cash holding are significantly positively correlated at the 1% significance level, while the Midwest region is subject to a higher degree of financing constraints compared to the Eastern region ($0.322 > 0.226$). In the eastern subsample, the interaction term between supply chain finance and cash flow is negatively correlated with cash holdings at the 5% significance level with an impact coefficient of -0.803, while this variable is not significant in the non-eastern regions, indicating that supply chain finance effectively alleviates the financing constraints of SMEs in the eastern regions, while the corresponding alleviation effect is weak in the central and western regions probably due to the lagging development of supply chain finance. The interaction term of fintech, supply chain finance and cash flow, $\text{Infintech} \times \text{SCF} \times \text{CF}$, is significantly and negatively correlated with cash holdings in the eastern subsample at the 5% significance level with an estimated coefficient of -0.128, while it is not significant in the central and western regions, indicating that fintech can promote the mitigation effect of supply chain finance development on financing constraints for eastern firms, while fintech in the non-eastern regions Fintech development does not affect the mitigation effect on supply chain finance.

Table 5. Regression results by region grouping

Variables	Model (4-1)	Model (4-2)	Model (5-1)	Model (5-2)	Model (6-1)	Model (6-2)
	Eastern Group	Non-Eastern Group	Eastern Group	Non-Eastern Group	Eastern Group	Non-Eastern Group
CF	0.226***	0.322***	0.375***	0.328***	0.331***	0.380***
	(6.38)	(5.28)	(5.87)	(2.81)	(6.07)	(4.25)
SCF			0.194***	0.230***	0.182***	0.225***
			(5.17)	(3.76)	(4.93)	(3.61)
CF_SCF			-0.803**	0.173		
			(-2.46)	(0.33)		
CF_SCF_Infintech					-0.128**	-0.049
					(-2.10)	(-0.34)
SZ	0.016***	0.025**	0.020***	0.036***	0.021***	0.032**
	(2.72)	(2.01)	(3.43)	(2.83)	(3.52)	(2.47)
RI	0.160***	0.145***	0.092***	0.045	0.091***	0.036
	(6.96)	(3.75)	(3.40)	(1.00)	(3.32)	(0.76)
GRO	-0.003	-0.003	-0.002	-0.004	-0.002	-0.004
	(-0.64)	(-0.39)	(-0.47)	(-0.58)	(-0.41)	(-0.49)
ΔNWC	0.384***	0.463***	0.391***	0.474***	0.391***	0.457***
	(22.73)	(16.56)	(23.31)	(17.15)	(23.18)	(15.88)
ΔCE	-0.086*	-0.023	0.088*	0.006	0.087*	-0.039
	(1.76)	(-0.30)	(1.82)	(0.08)	(1.78)	(-0.50)
Time Effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry Effect	Yes	Yes	Yes	Yes	Yes	Yes
N	1700	500	1700	500	1700	500
R-squared	0.324	0.444	0.324	0.465	0.336	0.450

2) Heterogeneity of enterprise types

In this paper, the full sample is divided into state-owned enterprise group and private enterprise group according to the nature of enterprises, among which the private enterprise group is 1855, much more than the state-owned enterprise group. As can be seen from Table 6, the coefficients of the pre-cash flow (CF) regressions are all significantly positive, proving the existence of financing constraints, but the alleviating effect is not significant. In the subsample of private enterprises, the coefficients of the cross product term $\ln\text{fintech} \times \text{SCF} \times \text{CF}$ for fintech, supply chain finance and cash flow are significant at the 5% significance level, indicating that fintech has a significant effect on private enterprises' development of supply chain finance to alleviate financing constraints play a facilitating role, while the moderating effect of SOEs is not significant probably due to the fact that financing activities are not dependent on fintech.

Table 6. Regression results for the grouping of firms by nature

Variables	Model (7-1) State-owned enterprise group	Model (7-2) Private Enterprise Group	Model (8-1) State-owned enterprise group	Model (8-2) Private Enterprise Group	Model (9-1) State-owned enterprise group	Model (9-2) Private Enterprise Group
CF	0.335*** (5.33)	0.232*** (6.76)	0.460*** (4.20)	0.336*** (5.27)	0.378*** (4.09)	0.331*** (6.26)
SCF			0.137* (1.77)	0.201*** (5.70)	0.124 (1.57)	0.195*** (5.60)
CF_SCF			-0.700 (-1.33)	-0.469 (-1.47)		
CF_SCF_ $\ln\text{fintech}$					-0.058 (-0.43)	-0.118** (-1.95)
SZ	0.008 (0.57)	0.018*** (3.11)	0.009 (0.72)	0.024*** (4.05)	0.013 (0.97)	0.023*** (3.93)
RI	0.218*** (4.86)	0.149*** (6.77)	0.171*** (3.15)	0.071*** (2.74)	0.177*** (3.19)	0.067** (2.53)
GRO	-0.013 (-1.46)	-0.002 (-0.34)	-0.010 (-1.16)	-0.001 (-0.31)	-0.012 (-1.39)	-0.001 (-0.15)
ΔNWC	0.474*** (13.85)	0.393*** (24.65)	0.472*** (13.67)	0.402*** (25.34)	0.480*** (13.81)	0.395*** (24.62)
ΔCE	-0.075 (-0.82)	0.080* (1.73)	-0.065 (-0.71)	0.087* (1.89)	-0.061 (-0.66)	0.072 (1.56)
Time Effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry Effect	Yes	Yes	Yes	Yes	Yes	Yes
N	365	1,855	365	1,855	365	1,855
R- squared	0.306	0.335	0.469	0.349	0.472	0.342

4.5. Robustness Test

To ensure the reliability of the research findings, this paper uses the digital financial development index instead of the level of fintech development as the core explanatory variable to test the robustness of the model with reference to the validation method provided by the

existing results. After testing, it is found that the empirical results do not change significantly, which proves that the empirical results are robust.

5. Research Conclusions and Recommendations

This paper empirically examines the impact of supply chain finance on alleviating corporate financing constraints and the development of financial technology on supply chain finance to alleviate financing constraints using data from SMEs listed on the Shenzhen Stock Exchange. It is found that the development of supply chain finance can alleviate the financing constraints faced by SMEs in China, and the development of financial technology can help supply chain finance to alleviate the financing constraints. Based on the research findings, this paper puts forward corresponding suggestions.

From the perspective of enterprises themselves, they should strengthen credit management and guarantee system to enhance their ability to utilize supply chain finance; establish cooperative relationships with large enterprises for mutual benefit and win-win situation, and use it to increase credit availability; pay attention to innovation within enterprises to fully grasp the role played by financial technology in alleviating financing constraints.

From the perspective of financial technology innovation, strengthen the awareness of developing supply chain finance, and use financial technology to promote the development of supply chain finance and alleviate financing difficulties. We should use big data and cloud computing to pinpoint customers, analyze the financing needs of different groups, develop diversified projects and products, and promote rational allocation of resources; use Internet platforms to digitalize the operation process and improve efficiency while reducing costs; use blockchain technology to transfer the credit of core enterprises to distributors at all levels and provide financing opportunities for larger-scale long-tail users; use big data analysis and artificial intelligence to establish safety and security as well as risk warning and response systems to analyze and control the overall risk, reduce moral hazard caused by information asymmetry, and lower the rate of non-performing loans.

From the perspective of macro management, the government should increase financial subsidies to encourage financial institutions to provide loans to SMEs that meet the relevant conditions; encourage the development of credit rating agencies, strengthen the construction of information platforms, reduce information asymmetry among supply chain finance participants, and clear the obstacles for SMEs to obtain financing; set up incentive mechanisms to encourage the development of financial technology and guide the innovation of enterprises and financial institutions.

References.

- [1] Allen N. Berger, Gregory F. Udell. A more complete conceptual framework for SME finance[J]. *Journal of Banking and Finance*, 2006, 30(11).
- [2] Almeida, H. and Campello, M., Financial Constraints, Asset Tangibility and Corporate Investment. SSRN[R]. Working Paper, 2004.
- [3] Cui, H.H., Zhang, Dunli. Can government subsidies alleviate corporate financing constraints? --An analysis of data based on pig enterprises[J]. *Finance and Accounting Newsletter*, 2021(03):77-82. DOI:10.16144/j.cnki.issn1002-8072.2021.03.015.
- [4] Chen P, Zheng You, Kong Liu Liu. Analysis of the impact of supply chain finance on SME financing--based on game theory perspective[J]. *China Business Journal*, 2015(10):75-77.
- [5] Cheng Jing, Hu Jinlin. Exploration of the path of Internet finance to solve the financing difficulties of small and medium-sized enterprises[J]. *Business Economics Research*, 2019(01):172-175.

- [6] Dong Xiaolin, Zhu Minjie, Yang Xiaoli. Information constraint, network structure and the design of micro and small financial inclusion mechanism--and the standardized development of China's Internet financing platform [J]. Research in Financial Economics, 2016, 31(7): 96- 105.
- [7] Fazzari S M, Hubbard R G, Petersen B C. Financing Constraints and Corporate Investment[J]. Brookings Papers on Economic Activity,1988,1988(1).
- [8] Huang R, Lai XB, Zhao DN, Tang ZL. Can digital finance alleviate corporate financing dilemmas - utility identification, characteristic mechanism, and regulatory assessment [J]. China Economic Issues,2021(01):52-66. doi:10.19365/j.issn1000-4181.2021.01.05.
- [9] Li Y, Hu Bianqi. Does information asymmetry necessarily lead to financing constraints? --- An empirical analysis based on Chinese listed companies [J]. Research in Financial Economics,2016(1).
- [10] Jiang Huifeng, Liu Yiping. Digital finance, supply chain finance and corporate financing constraints- Empirical evidence based on small and medium-sized enterprise board listed companies[J]. Technology Economics and Management Research,2021(03):73-77.
- [11] Song M, Zhou P, Si H. Fintech and Total Factor Productivity of Firms - An "Empowerment" and Credit Rationing Perspective[J]. China Industrial Economics,2021(04):138-155.
- [12] Thorsten Beck, Asli Demirgüç-Kunt, Vojislav Maksimovic. Financing patterns around the world: Are small firms different? Journal of Financial Economics,2007,89(3).
- [13] Xu Gaojie, Xu Qian, Yu Wanxin, Zhang Li, Liu Chang. Analysis of countermeasures for financing constraints of science and technology-based SMEs[J]. Small and medium-sized enterprise management and science and technology (upper journal),2021(07):87-88.
- [14] Wei, Cheng-Long, Guo, Coffee. Research on financial technology innovation and alleviation of corporate financing constraints - based on financial technology index measurement and empirical analysis [J]. Price Theory and Practice 2020(01):163-166.
- [15] Wang Xiangning, Liu Xiao. The impact of fintech on financing constraints of SMEs [J]. Statistics and Decision Making,2021,37(13):151-154.DOI:10.13546/j.cnki.tjyc.2021.13.035.
- [16] YAN Hongguo, Lv Yuanyuan. Supply chain concentration, supply chain finance and corporate financing constraints [J]. Journal of Hangzhou University of Electronic Science and Technology (Social Science Edition),2020,16(06):16-24.DOI:10.13954/j.cnki.hduss.2020.06.003.
- [17] Yao Wangxin, Xia Juan, Sun Tingting. Research on financing constraints of science and technology-based SMEs and their mitigation from the perspective of supply chain finance [J]. Science and Technology Progress and Countermeasures, 2017, 34(4): 105- 110.
- [18] Zhu Jun. Technology absorption, government promotion and total factor productivity improvement in China [J]. China industrial economy.2017,(1):5-24.
- [19] Zhang Jian, Long Yunan, Ai Rong. The mitigating effect of supply chain finance on financing constraints of industry-finance integrated enterprises--based on the perspective of inter-firm connected transactions[J]. Business Economics Research,2019(18):166-169.
- [20] Zhou Xuemin, Xu Peng, Deng Zhefeng. Incentives and supervision of third-party logistics by entrustment model financing warehouse banks under information asymmetry [J]. Journal of Southwest Normal University,2015(5):82-87.
- [21] Zhang Weibin, Liu Ke. Can the development of supply chain finance reduce the financing constraints of small and medium-sized enterprises? --An empirical analysis based on small and medium-sized listed companies[J]. Economic Science,2012(03):108-118.DOI:10.19523/j.jjlx.2012.03.010.