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Fintech, Financing Constraints and Total Factor Productivity of Enterprises

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Abstract

Based on the data of Shanghai and Shenzhen A-share non-financial listed enterprises from 2011 to 2018, this paper studies the impact of fintech on the total factor productivity of enterprises. The results show that: (1) fintech has a significant positive impact on the total factor productivity of enterprises. After endogenous and robustness tests, the conclusion is robust. (2) The results of the mechanism show that fintech can promote TFP by easing the financing constraints. (3) In the heterogeneity test, fintech plays a more obvious role in promoting total factor productivity of non-state-owned enterprises, high debt ratio enterprises and enterprises at the low level of traditional financial development.

Keywords

Fintech; Financing Constraints; Enterprise Total Factor Productivity.

1. Introduction

Since the reform and opening up, China's economy has entered the fast lane. With a large amount of investment, land development and low-cost labor, China's economy has maintained a long-term high-speed growth. However, with the development of China's economy to a new stage, this extensive growth model has been difficult to maintain. The report of the 19th National Congress of the Communist Party of China pointed out that China's economy has shifted from high-speed growth to high-quality growth. From the micro level, high-quality growth means that enterprises must constantly improve their efficiency, which is often measured by the total factor productivity after deducting the contribution of capital and labor. According to the classic literature of TFP measurement, there are several ways for enterprises to improve total factor productivity. The first is to invest in R & D for innovation and obtain TFP improvement brought about by technological progress. Secondly, enterprises expand reproduction to obtain scale effect and enhance TFP. Finally, the pure efficiency improvement brought by the improvement of management and system has also been widely studied.

However, the problem faced by all micro enterprises in China is that they need financial support to innovate and adjust the optimal scale. In particular, some small and medium-sized enterprises, which have contributed most of China's technological innovation, urgently need to integrate resources to achieve the optimal scale, but the financing constraints they face are also evident. First of all, due to the serious information asymmetry brought about by innovation activities, small and medium-sized enterprises have the problem of difficult loans. At the same time, small and medium-sized enterprises lack guarantees, lack of credit records, and generally have the problem of expensive loans. These two aspects limit the incentives for SMEs to improve total factor productivity.

In recent years, with the development of artificial intelligence, big data, blockchain and other technologies and their wide application in the financial field, the concept of financial technology came into being. Fintech can alleviate the information asymmetry in the process of enterprise loans to a certain extent, and provide more convenient and efficient financial services for small

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and medium-sized enterprises, which provides an opportunity to solve the above contradictions. In August, 2019, the central bank issued the top-level design document "financial technology development plan (2019-2021)", which has attracted the government's attention at the strategic level, and to a large extent, it shows that financial technology is indispensable.

Based on this, this paper mainly studies the following questions: is there any financing constraint for enterprises to improve total factor productivity? Can fintech effectively improve the total factor productivity of enterprises? What is its theoretical basis? Therefore, the following parts of this paper are arranged as follows: the second part reviews the previous studies of scholars and clarifies the marginal contribution of this paper. The third part constructs the theoretical model and further puts forward the research hypothesis of the empirical part. The fourth part is empirical test and robustness test. Finally, this paper summarizes the conclusions and gives the corresponding policy recommendations.

2. Literature Review

According to the research theme of this paper, the relevant literature is divided into two clues, namely, the research on financial technology and the research on total factor productivity by financial technology.

The first is the research on financial technology. As a product of the combination of Finance and technology, financial technology has developed rapidly, and many fields are affected by it. At present, the research on financial technology is mainly carried out from financial supervision and Inclusive Finance.

The first part is the research on financial technology and financial supervision. Many literatures point out that the development of financial technology will increase financial risks, but some literatures point out that financial technology will increase the ability of financial institutions to resist risks, but the existing literatures point out that it is necessary to strengthen the financial supervision system. Gao Xingwei (2022) pointed out that at present, not only are they facing new financial risks under the Internet, but traditional financial risks still exist, and the two are easy to resonate. Therefore, it is necessary to establish a supervision system of financial technology dimension under the traditional financial supervision to form a new financial supervision system. Hu bin and renxiping (2021) also pointed out that although the use of financial technology has greatly reduced the cost of financial services, as a new thing, the development of financial technology has posed new challenges to supervision. Therefore, we should pay attention to strengthening supervision while developing financial technology. However, liuzhiyang (2021) pointed out that fintech has not changed the essence of finance. On the contrary, the development of fintech will increase the ability of financial institutions to resist risks. In addition, in order to deal with the unknown risks brought by fintech, relevant departments should find new measures to improve regulatory efficiency.

The second part is the research on fintech and Inclusive Finance. Fengsuling et al. (2021) made an empirical analysis by using the data of 283 cities in China, pointing out that the development of fintech has improved the inclusive and affordable nature of finance. However, there is a certain threshold effect in this effect. Generally, the higher the financial supervision, the greater the improvement effect. However, when the financial supervision is too strict, the impact of fintech on improving financial inclusiveness will be reduced. Fuqiong and guojiayu (2021) pointed out that financial technology has brought hope to Inclusive Finance, has an obvious promoting effect on solving rural financial problems, and can effectively promote the sustainable development of inclusive amount. Therefore, we should further promote the development of rural Inclusive Finance by strengthening supervision and other measures. Li et al. (2020) empirically concluded that the development of financial technology can improve the

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inclusive nature of finance, thus increasing the consumption level of rural residents. Lijianjun and jiangshichao (2021) pointed out through theoretical analysis that fintech can not only expand the scope of financial services, but also improve the profitability of commercial banks. Therefore, fintech can be vigorously developed to promote the sustainability of Inclusive Finance. It can be seen that existing studies have pointed out that the development of financial technology can effectively promote the promotion of Inclusive Finance.

The second is about the impact of financial technology on total factor productivity. The existing research is mainly divided into two parts, namely, the impact of financial technology on total factor productivity of a single industry and the impact on total factor productivity of the whole industry.

The first part is about the impact of financial technology on the total factor productivity of a specific industry. Zhang Qian and Zhao Xin (2019) analyzed the data of 26 banks, and the results showed that the improvement of the level of financial innovation of banks can lead to the improvement of the technological progress of banks, thus promoting the total factor productivity of the banking industry. Liumengfei et al. (2021) reached the same conclusion through theoretical and empirical analysis, and also pointed out that the promotion effect of fintech varies with the size of banks. Yao et al. (2021) studied the impact of financial technology on green total factor productivity. The results show that the level of financial technology can significantly promote green total factor productivity through industrial structure upgrading and technological innovation. Liu Fang and zhaoyanyun (2020) studied the relationship between financial support and total factor productivity of high-tech industries. The results show that financial support can improve total factor productivity of high-tech industries, but financial subsidies will reduce this effect.

The second part is the impact of financial technology on the total factor productivity of the whole industry. Tang Song et al. (2019) pointed out that the development of financial technology can alleviate information asymmetry and improve total factor productivity, and this effect can improve the total factor productivity of surrounding areas through spatial spillovers. Hou layer and Li Beiwei (2020) used inclusive finance index to discuss this issue, and pointed out that financial technology can promote TFP, and this effect is more significant in technology intensive and capital intensive industries. Ba Shusong et al. (2020) conducted empirical analysis on this issue from the perspective of new structural economics. The results show that the improvement of financial technology can promote the total factor productivity of enterprises and further promote economic growth, but the path to promote economic growth has a threshold effect.

Through the above literature review, it can be found that when discussing the impact of the development of financial technology, the previous literature mainly studies the impact of financial technology on the macro level, such as the impact of financial technology on financial regulation and Inclusive Finance. Only a few scholars pay attention to the impact of financial technology on total factor productivity, and many literatures only pay attention to the impact on a single industry. Noting this, this paper explores the relationship between fintech and total factor productivity of enterprises, and further studies its transmission path, which can enrich the existing research to a certain extent.

The possible specific contributions of this paper are as follows: first, unlike previous literatures that use the Peking University Digital inclusive financial index to represent the development level of financial technology, this paper uses text mining to build the financial technology development index, which more accurately identifies the development level of financial technology. Second, on the basis of previous studies, this paper further explores the path that financial technology affects the total factor productivity of enterprises. Thirdly, this paper not only uses conventional means, but also uses did to discuss the endogenous problems when dealing with the endogenous problems, so the conclusion can basically exclude the existence of

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endogenous problems. Fourthly, on the benchmark regression of the impact of fintech on the total essential number productivity of enterprises, this paper discusses the heterogeneity in many aspects, which further strengthens the credibility of this conclusion.

3. Theoretical Model and Research Hypothesis

In order to explore the relationship between financial technology and enterprise total factor productivity, this paper constructs a theoretical model for analysis. It is assumed that the activities of representative enterprises (such as manufacturing) are mainly divided into two phases. In the first phase, enterprises choose whether to invest in R & D. For simplicity, the case of R & D failure is not considered. R & D needs to invest cost of C_I. The second phase enterprises can choose to maintain the existing scale or expand the production scale when they are put into production. The expansion of the scale requires invest cost of C_S According to the classical theory of corporate finance, the cost of internal financing is lower than that of external financing. Therefore, in the first phase of investment, enterprises give priority to internal financing, and in the second phase of expanded reproduction, external financing is required. Assume that the cost of internal financing is standardized as 1, and the cost of external financing is set as γ $(\gamma > 1)$.

Further, suppose that the probability that internal financing is sufficient to support innovation and expand reproduction is q, The probability of external financing gap is $(1-q)$. The probability that an enterprise has an external financing gap will be affected by the following factors. First, when there is an exogenous liquidity shock, it may increase the possibility of external financing. Second, enterprises decide to invest in innovation in the first phase, which will increase the possibility of external financing. Third, in the second phase, enterprises decide to expand, which will also increase the possibility that enterprises need external financing. Suppose that the probability of the three events increasing the financing gap of the enterprise is δ_L、δ_I、δ_S. In the first phase, the enterprise considers whether to invest in R & D. the enterprise can use free funds or external financing to carry out R & D and innovation. The profits obtained are recorded as $\pi_i^I, i \in \{1, \gamma\}$. When the enterprise does not invest in R & D in the first phase, the profit is π_i, Because it is assumed that there is no failure in R & D $\pi_i^I > \pi_i$, Therefore, if an enterprise uses external financing to invest R & D funds, the interest margin between the two will decrease with the increase of financing costs, $\partial(\pi_\gamma^I - \pi_\gamma)/\partial\gamma < 0$. Whether the phase I enterprise has invested in R & D, Δ_π^I depends on the profit difference between R & D and non R & D:

$$\Delta_\pi^I = E(\pi|I) - E(\pi) = (q-\delta_L)(\pi_1^I - \pi_1) + (1-q+\delta_L)(\pi_\gamma^I - \pi_\gamma) - \delta_I(\pi_1^I - \pi_\gamma^I) - F_I$$

In the second phase, the enterprise considers whether to expand reproduction. Similarly, the enterprise can use internal funds and external financing to expand reproduction, and the profits obtained are recorded as $\pi_i^S, i \in \{1, \gamma\}$. When the enterprise does not expand reproduction, the profit is π_i. Because the research perspective is mainly focused on small and medium-sized enterprises, which are far from reaching the optimal scale, the marginal cost of production decreases with the scale, $\pi_i^S > \pi_i$. At the same time, with the increasing cost of financing, the income from expanding reproduction will decrease, $\partial(\pi_\gamma^S - \pi_\gamma)/\partial\gamma < 0$. Whether phase II enterprises choose to expand production, Δ_π^S depends on the profit difference between the two types of decisions:

ISSN: 2688-9323

$$\Delta_{\pi}^{S} = E(\pi|S) - E(\pi) = (q-\delta_S)(\pi_1^S - \pi_1) + (1-q+\delta_L)(\pi_\gamma^S - \pi_\gamma) - \delta_S(\pi_1^S - \pi_\gamma^S) - F_S$$

A large number of studies show that the financing cost of enterprises is affected by many factors. The most important one is the development of financial technology, because the development of financial technology can effectively weaken the financial constraints of companies and significantly reduce their financing costs. On the one hand, due to asymmetric information, financial institutions need to strengthen the approval of the company's capital injection, and this part of the cost will be borne by the company that needs financing. At the same time, it is impossible to assess whether the company can obtain funds, which will further increase its financing restrictions. On the other hand, the development of financial technology can "empower" traditional institutions and provide enterprises with more and more convenient credit rationing. Secondly, equity heterogeneity affects the financing cost of the company. With its abundant capital, good reputation and indirect government guarantee, the financing cost of state-owned enterprises is often low. The obstacles for private enterprises to enter the financial market are obvious. Most loans need collateral, and the financing cost is very high. In addition, with the improvement of the financial market, the company's own financial situation will also affect the company's financing cost. Therefore, this paper assumes that the financing cost of the enterprise γ The following rules are met:

$$\gamma = f(FT, EQU, LSR, FD), \partial f / \partial FT < 0$$

Therefore, based on the derivation of the comprehensive theoretical model, enterprises can improve their own total factor productivity from technological innovation and scale expansion, and the relationship between it and fintech can be expressed as follows:

$$\frac{\partial TFP}{\partial FT} = (\frac{\partial \Delta_{\pi}^{I}}{\partial \gamma} + \frac{\partial \Delta_{\pi}^{S}}{\partial \gamma})\frac{\partial \gamma}{\partial FT} = [(1-q+\delta_L)\frac{\partial(\pi_\gamma^I - \pi_\gamma)}{\partial \gamma} + \delta_I \frac{\partial \pi_\gamma^I}{\partial \gamma} + (1-q+\delta_L)\frac{\partial(\pi_\gamma^S - \pi_\gamma)}{\partial \gamma} + \delta_S \frac{\partial \pi_\gamma^S}{\partial \gamma}]\frac{\partial f}{\partial FT}$$

Upper formula, $(1-q+\delta_L)\frac{\partial(\pi_\gamma^I - \pi_\gamma)}{\partial \gamma} + \delta_I \frac{\partial \pi_\gamma^I}{\partial \gamma}$ and $(1-q+\delta_L)\frac{\partial(\pi_\gamma^S - \pi_\gamma)}{\partial \gamma} + \delta_S \frac{\partial \pi_\gamma^S}{\partial \gamma}$ Less than 0 respectively, $\frac{\partial f}{\partial FT}$ also less than 0. Therefore, the whole equation is greater than 0, That is, the increase of financial technology helps enterprises improve total factor productivity, And it is a channel of γ to alleviate financing constraints, Based on this, this paper proposes the following two assumptions:

Hypothesis 1: the development of financial technology will improve the total factor productivity of enterprises.

Hypothesis 2: financing constraint is an intermediary variable in the process of fintech affecting TFP.

At the same time, due to $\gamma = f(FT, EQU, LSR, FD)$, Therefore, there may be heterogeneity related to enterprise ownership, asset liability ratio and financial development in the process of fintech affecting enterprise total factor productivity. Based on this, this paper puts forward the following assumptions:

Hypothesis 3: if fintech improves the total factor productivity of enterprises, there will be heterogeneity in enterprise ownership, asset liability ratio and financial development.

ISSN: 2688-9323

4. Model Setting and Variable Description

4.1. Model Setting

According to Hausman test, this paper constructs a fixed effect model to clarify the relationship between fintech and total factor productivity of enterprises:

$$TFP_{it} = \beta_0 + \beta_1 FintechN_{it} + \beta_2 control_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (1)$$

Where TFP_{it} represents the total productivity of the enterprise, $FintechN_{it}$ represents financial technology (prefecture level city level), and $control_{it}$ represents some columns of control variables, γ_i and δ_t is the fixed effect of individual business and year, ε_{it} stands for random disturbance term.

The benchmark model can prove that fintech has an impact on the total factor productivity of enterprises, but it is necessary to further analyze the transmission mechanism. This paper uses the research design of wenzhonglin et al. (2004) for reference, and studies the mechanism by establishing an intermediary effect model. The intermediary mechanism test is divided into three steps. The first step is to use the total factor productivity of enterprises to regress the financial technology to test whether the financial technology has an impact on the total factor productivity of enterprises without intermediary variables, that is, whether a_1 is significantly non-zero; The second step is to test the relationship between intermediary variables and fintech, that is, the significance of coefficient b_1; The third step is to add intermediary variables to the original benchmark model to study the significance of coefficient c_2. If $c_2$and b_1 are significant at least at the 10% level, it indicates that this mediating mechanism exists.

$$TFP_{it} = a_0 + a_1 FintechN_{it} + a_2 control_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (2)$$

$$Med_{it} = b_0 + b_1 FintechN_{it} + b_2 control_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (3)$$

$$TFP_{it} = c_0 + c_1 FintechN_{it} + c_2 Med_{it} + c_3 control_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (4)$$

4.2. Variable Description

4.2.1. Fintechn

This paper takes the year, region and keywords as the initial search terms, in which the year is selected from 2011 to 2018, the region is at the prefecture level city and municipality level, and the keywords refer to the research of Songmin et al. (2021), and use Python to crawl the enterprises containing keywords in the "sky eye search" to obtain the number of fintech related enterprises (at the prefecture level city level), This paper also adds one to the number of enterprises and then logarithm to get the fintech index.

4.2.2. Enterprise Total Factor Productivity:

Referring to many literatures, this paper uses LP method to estimate the total factor productivity of enterprises. In the robustness test, OP method and GMM method are used to re measure the total factor productivity of enterprises.

4.2.3. Mediating Variable

This paper uses SA index to measure corporate financing constraints. $SA = (-0.737) \times lnSZ + 0.043 \times (lnSZ)^2 - 0.04 \times age$, $SZ =$ Total assets of the enterprise/1000000 , age is the difference between the sample observation time and the establishment time of the enterprise. It should be noted that the SA index is negative after measurement. The larger the index is, the greater the problem of financing the enterprise.

ISSN: 2688-9323

4.2.4. Control Variable

(1) scale: Logarithm of total assets of the enterprise;(2) age: The difference between the sample observation year and the enterprise establishment year;(3) Equity: The ratio of the number of shares held by the largest shareholder to the total number of shares;(4) lev The ratio of total liabilities to total assets of the enterprise;(5) roa: Ratio of net profit to total assets;(6) dual: when the chairman of the board and the general manager are concurrently appointed; otherwise, 0;(7)gl: The ratio of administrative expenses to operating income;(9) gdpg: (GDP of the current year - GDP of the previous year) / GDP of the previous year;(10) govi: The ratio of general budget expenditure to GDP.

4.3. Data Sources

In order to test the theoretical hypothesis, the number of financial technology companies at prefecture level and city level is used to analyze the impact of financial technology on the total factor productivity of enterprises. In order to obtain sufficient data, Shanghai and Shenzhen A-share listed companies are taken as the research samples, the time frame is set for 2011-2018, the enterprise level data are from CSMAR and wind databases, and the number of fintech companies is from the "tianyancha" website; Macro level data are from EPS database and China Statistical Yearbook. This paper also carries out the following data processing: (1) eliminate st and *st enterprises; (2) Exclude the listed enterprises within the sample period; (3) Enterprises with less than 100 employees shall be excluded; (4) Exclude financial enterprises; (5) Enterprises with missing or abnormal financial data shall be excluded. Descriptive statistics are shown in Table 1.

Table 1. Descriptive Statistics

Variable	N	Mean	Sd	Min	Max
tfp_lp	7408	16.66	1.084	13.85	21.1
tfp_op	7408	15.61	0.944	12.81	20.01
tfp_gmm	7408	10.06	0.897	7.564	15.21
FintechN	7408	3.229	2.114	0	9.151
scale	7408	22.66	1.388	18.95	28.52
age	7408	18.65	5.196	3	40
Equity	7408	35.84	15.42	3.62	89.99
lev	7408	0.479	0.197	0.007	0.964
roa	7408	0.042	0.044	-0.554	0.372
dual	7319	0.191	0.393	0	1
gl	7408	0.082	0.061	0.001	0.65
gdpg	7408	0.099	0.046	-0.224	0.263
govi	7408	0.195	0.066	0.11	0.627
SA	7408	-3.818	0.265	-4.754	-2.118

5. Empirical Analysis

5.1. Benchmark Regression

In Table 3, column (1) (2) does not control the fixed effect of the year, (1) (3) does not add control variables, and column (4) is the regression result of the benchmark model in this paper. Empirical results show that financial technology has a positive impact on the total factor productivity of enterprises, and it is significant at the 1% level. The possible reason is that through digital information technology, financial technology has increased the information

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transparency of enterprises, greatly alleviated the information asymmetry between traditional financial institutions such as banks and enterprises, greatly improved the ability and efficiency of enterprises to borrow funds, and finally improved the operating efficiency of enterprises. Hypothesis 1 has been verified.

The control variables in Table 3, such as the ROA coefficient, are significantly positive, indicating that the stronger the profitability of the enterprise, the higher the total factor productivity, because a strong profitability means that the enterprise has high-quality cash flow and can support various business decisions; GL coefficient is significantly negative, indicating that the improvement of management efficiency can improve the total factor productivity of enterprises.

Table 2. Benchmark Regression

	tfp_lp			
	(1)	(2)	(3)	(4)
FintechN	0.216***	0.036***	0.066***	0.038***
	(0.005)	(0.009)	(0.014)	(0.009)
scale		0.520***		0.518***
		(0.008)		(0.008)
age		-0.006*		-0.010***
		(0.004)		(0.004)
Equity		0.000		0.000
		(0.000)		(0.000)
lev		0.222***		0.219***
		(0.037)		(0.037)
roa		1.831***		1.800***
		(0.095)		(0.095)
dual		0.001		0.000
		(0.011)		(0.010)
gl		-4.727***		-4.823***
		(0.106)		(0.110)
gdpg		-0.025		-0.066
		(0.074)		(0.097)
govi		-0.356*		-0.158
		(0.214)		(0.242)
_cons	15.968***	5.158***	16.280***	5.244***
	(0.016)	(0.166)	(0.033)	(0.172)
Ind FE	YES	YES	YES	YES
Year FE	NO	NO	YES	YES
N	7408	7319	7408	7319
r2_a	0.126	0.647	0.149	0.649

Note: standard errors are shown in brackets, *, * *, * * * are significant at 10%, 5% and 1% respectively, the same below.

5.2. Endogenetic Test

5.2.1. Tool Variable Method (iv-2sls)

This paper refers to the research and design of wangyanan et al. (2020). The tool variable adopts the lag phase I data of fintechn. The results are shown in Table 4. (1) Listed as the first stage in 2SLS, the first-order lag coefficient of fintechn is significantly positive, indicating the

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correlation between fintech index and instrument variables; (2) Listed as the second stage of 2SLS, the fintech index coefficient is significantly positive, indicating that the conclusion of this paper has not changed after alleviating the endogenous problem. It further verifies hypothesis 1.

5.2.2. Difference-in-Difference (DID)

With reference to the research of Qian Haizhang et al. (2020) and Song Min et al. (2021), and taking the G20 advanced principles of digital Inclusive Finance issued by the central bank in 2016 as the quasi natural experiment, the division of enterprises in the experimental group and the control group is based on the median digitalization degree at the prefecture level in 2015. The DID model is as follows:

$$TFP_{it} = d_0 + d_1 Treat_{it} \times Post_{it} + d_3 control_{it} + \gamma_i + \delta_t + \varepsilon_{it} \quad (5)$$

Among them, Treat identifies the experimental group and the control group, and Post is the time point variable. If it is an enterprise of the experimental group, the Treat is 1, and the treat of the enterprise of the control group is 0; If the year is greater than or equal to 2016, the Post is recorded as 1, otherwise it is 0; This article will focus on The coefficient d_1 of Treatit×Postit, if d_1 is significantly positive, indicates that the promotion effect of enterprise total factor productivity is more obvious in areas with large policy impact, that is, financial technology has a significant role in promoting enterprise total factor productivity. Table 4 (3) shows the did regression results. The d_1 coefficient is significantly positive at the 5% level, indicating that hypothesis 1 is still valid after considering the endogenous problem.

Table 3. Endogenetic Test

	FintechN	**tfp_lp**	**tfp_lp**
	First	Second	DID
IV	0.700***		
	(0.010)		
FintechN		0.038***	
		(0.014)	
Treat_Post			0.033**
			(0.013)
_cons	-0.261	5.099***	4.776***
	(0.297)	(0.188)	(0.271)
control	YES	YES	YES
Ind-year	YES	YES	YES
N	6401	6401	6410
r2_a	0.930		0.619

5.3. Robustness Test

5.3.1. Change the Calculation Method for the Explained Variable

The OP and GMM methods are used to re calculate the TFP of the enterprise. The robustness test results are shown in Table 5 (1) (2). The results show that even if the measurement method is changed, the coefficient of fintech is significant at the level of 1%. The conclusion of this paper is robust.

5.3.2. Control the Level of Financial Development

In order to exclude the influence of financial development level on the results, this paper controls the results of financial development level in the benchmark model, as shown in Table

5 (3). The results show that after controlling the level of financial development, the conclusion of this paper is robust.

5.3.3. Exclude the Samples from Municipalities Directly under the Central Government

Compared with other prefecture level cities, municipalities directly under the central government have greater economic particularity, and the number of fintech companies is quite different between municipalities directly under the central government and other prefecture level cities. Therefore, this paper excludes the samples of municipalities directly under the central government and returns. The results are shown in column (4) of table 5, and the conclusion of this paper is still robust.

Table 4. Endogenetic Test

	tfp_op	tfp_gmm	tfp_lp	tfp_lp
	(1)	(2)	(3)	(4)
FintechN	0.026**	0.039***	0.038***	0.035***
	(0.011)	(0.012)	(0.009)	(0.010)
Jrfz			-0.004	
			(0.036)	
_cons	8.952***	7.753***	6.527***	6.310***
	(0.343)	(0.389)	(0.295)	(0.338)
control	YES	YES	YES	YES
Ind-year	YES	YES	YES	YES
N	7319	7319	7319	5686
r2_a	0.462	0.249	0.649	0.660

5.4. Mechanism Test

Column (1) of table 6 shows the impact of fintech on financing constraints. It can be seen that fintech has significantly eased corporate financing constraints. (2) Column shows the impact of financing constraints on the total factor productivity of enterprises. Financing constraints have a significant inhibitory effect on the total factor productivity of enterprises. It can be concluded that fintech can alleviate corporate financing constraints to enhance corporate TFP. Hypothesis 2 is true.

Table 5. Endogenetic Test

	SA	tfp_lp
	(1)	(2)
FintechN	-0.005***	0.037***
	(0.002)	(0.009)
SA		-0.145**
		(0.058)
_cons	-3.402***	6.032***
	(0.064)	(0.354)
control	YES	YES
Ind-year	YES	YES
N	7319	7319
r2_a	0.757	0.649

ISSN: 2688-9323

5.5. Heterogeneity Test

5.5.1. Heterogeneity of Property Rights

Table 7 (1) (2) shows the heterogeneous impact of fintech on total factor productivity in state-owned enterprises and non-state-owned enterprises. Among non-state-owned enterprises, fintech can significantly improve the level of total factor productivity of enterprises, alleviate the phenomenon of Financial Exclusion, and the improvement of financing constraints has brought more improvements in production efficiency, playing a role of "providing timely help". In the state-owned enterprises, the impact of fintech is not significant. The possible reason is that state-owned enterprises can obtain more funds in the traditional financial market than non-state-owned enterprises by virtue of their own property rights, and the effect of financial technology on them is limited.

5.5.2. Heterogeneity of Enterprise Asset Liability Ratio

Table 7 (3) (4) shows the heterogeneous impact of fintech on total factor productivity in different enterprise asset liability ratios. Fintech can improve the total factor productivity of enterprises with different debt ratios, but it has a stronger role in promoting high debt enterprises. This is because China's financial market is imperfect. As a credit rating standard for corporate financing, the enterprise asset liability ratio will increase the financing constraints of high debt ratio enterprises and intensify the exclusion of traditional finance (Tan xiaofen and Zhang wenjing, 2017). Fintech will serve product innovation through digital technology, reduce information asymmetry between banks and enterprises, improve enterprise risk control ability, and promote funds and financial products to serve tail customers.

5.5.3. Heterogeneity of Financial Development Level

Table 7 (5) (6) shows the impact of fintech on total factor productivity of enterprises at different levels of traditional financial development. The impact of fintech on total factor productivity of enterprises in areas with low level of traditional financial development is significantly higher than that in areas with low level of traditional financial development, indicating that fintech and traditional finance can complement each other.

The above three results prove the correctness of hypothesis three.

Table 6. Heterogeneity Test

	Property right nature		Asset liability ratio		Financial development level	
	State owned	Non state owned	high	low	high	low
FintechN	0.019	0.050***	0.054***	0.026**	0.010	0.034***
	(0.015)	(0.011)	(0.014)	(0.012)	(0.016)	(0.011)
_cons	6.200***	7.602***	6.543***	6.340***	7.222***	6.746***
	(0.468)	(0.380)	(0.463)	(0.383)	(0.481)	(0.382)
control	YES	YES	YES	YES	YES	YES
Ind-year	YES	YES	YES	YES	YES	YES
N	3106	4213	3656	3663	3254	4065
r2_a	0.705	0.566	0.572	0.642	0.530	0.680

6. Conclusion and Policy Recommendations

6.1. Conclusion

Based on the data of Shanghai and Shenzhen A-share non-financial listed enterprises from 2011 to 2018, this paper studies the impact of fintech on the total factor productivity of enterprises. The results show that: (1) fintech has a significant positive impact on the total factor productivity of enterprises. After endogenous and robustness tests, the conclusion is robust. (2)

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The results of the mechanism show that fintech can promote TFP by easing the financing constraints. (3) In the heterogeneity test, fintech plays a more obvious role in promoting total factor productivity of non-state-owned enterprises, high debt ratio enterprises and enterprises at the low level of traditional financial development.

6.2. Policy Recommendations

First, starting from the overall strategic situation, we should vigorously promote the development of financial technology. There is no doubt that the development of regional financial technology can promote the total factor productivity of enterprises. In the future, we need to deepen the combination of information technology and the financial industry, so as to better serve Chinese Enterprises.

Second, we should strengthen our understanding of the mechanisms and ways in which fintech plays a role in the total factor productivity of enterprises, and further expand the promotion effect. Capital is the driving force of enterprise development. Government agencies should issue corresponding policies to enable traditional financial institutions to combine with financial technology, make use of the characteristics of digital technology, alleviate the information asymmetry between banks and enterprises, and formulate targeted financial products and services for non-state-owned enterprises, high debt enterprises and enterprises located in low-level areas of traditional financial development.

Thirdly, fintech is a technological innovation of finance, but it is still finance in the final analysis. In order to prevent major financial risks that may arise, financial supervision should not be relaxed at any time, and fintech should serve the economy of Chinese enterprises in an appropriate range.

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