

A study on the impact of digital financial inclusion on the performance of small and medium-sized enterprises under the impact of COVID-19

ABSTRACT

At the beginning of 2020, the sudden epidemic of new coronavirus pneumonia spread across the country, and the sudden disaster affected all aspects of the production industry, especially for small and medium-sized enterprises with relatively weak overall strength, the impact of the epidemic is worse. From the perspective of the performance of small and medium-sized enterprises in China, this paper hopes to make an important breakthrough on whether digital inclusive finance can reduce the impact of the novel coronavirus epidemic on the performance of small and medium-sized enterprises through exploration in this paper, so as to supplement the research content of digital inclusive finance and small and medium-sized enterprises. On this basis, this paper intends to select listed enterprises on China's New Third Board as research samples, use the digital inclusive finance index compiled by Peking University to measure the development degree of digital inclusive finance in China, and conduct a quasi-natural experiment to study the impact of digital inclusive finance on the operation of small and medium-sized enterprises through the external impact affecting the operation of small and medium-sized enterprises. It is of reference significance for how to improve the performance of smes with the help of digital inclusive finance.

Keywords: Digital inclusive finance; Small and medium-sized enterprises; COVID-19; Enterprise performance

1.INTRODUCTION

During the Spring Festival of 2020, a large-scale novel coronavirus outbreak broke out, and the government quickly adopted a series of lockdown measures to restrict large crowds from gathering together in order to control the rapid development and spread of the epidemic as soon as possible. As the world's largest manufacturing country, the epidemic has had a great impact on all aspects of the production industry, especially for small and medium-sized enterprises, which are generally relatively vulnerable. The crisis has made their business survival a great impact, and there is a risk of capital chain break. As an indispensable part of the market economy, small and medium-sized enterprises play an irreplaceable role in promoting China's rapid economic growth, improving the level of social employment, and

improving the overall innovation and entrepreneurship ability. It can be seen that improving the operation ability of small and medium-sized enterprises is the micro foundation of China's economic development.

In the current situation of adopting a variety of closed regulatory means, the inclusive digital financial model has more advantages. Different from the traditional business financial model based on credit and mortgage, the network has brought massive big data to digital inclusive finance, and AI, cloud computing and other technologies have greatly improved the processing efficiency of big data. In order to effectively prevent people from crowding, many experts, scholars and entrepreneurs have suggested that we should actively promote inclusive finance to alleviate the crisis brought about by the impact of the epidemic.

Therefore, a series of questions remain to be answered, such as whether digital financial inclusion can help smes cope with the impact of the epidemic, whether smes really benefit from the development dividend of digital financial inclusion, and what economic effects it plays. This paper constructs a quasi-natural experiment to measure the impact of digital financial inclusion on the operation of small and medium-sized enterprises. A differential model is established to assess the impact of the epidemic on the performance of smes. Based on the above research, this paper analyzes whether digital inclusive finance can effectively reduce the adverse impact of the novel coronavirus pneumonia epidemic on the development of smes in China through the triple differential model, and then evaluates the supporting effect of digital inclusive finance on the operation of smes in China. This paper takes the empirical data of micro enterprises as the research object, evaluates the impact of the current epidemic impact on the real economy through empirical research, and provides a scientific reference for the application of digital inclusive finance to improve the operational stability of small and medium-sized enterprises in China.

2.MATERIAL AND METHODS

2.1 Research design

Under the impact of the epidemic, the business performance of small and medium-sized enterprises has been affected by many aspects, such as: enterprise characteristics, industry characteristics and social and economic environment. Therefore, there will be some bias in the research process. In order to reduce the interference of other factors on the research results, this paper intends to use the differential method to estimate the changes in the performance of smes under the impact of the epidemic. The rapid outbreak of the epidemic has a wide impact range, and the impact degree on various enterprises is different, which meets the exogenous requirements of the differentially differential model.

In order to better grasp the causal relationship between the impact of COVID-19 on the performance of smes, based on the classification of the treatment group and the control group

mentioned above, and with reference to existing research papers and model construction methods on DID, the following differential model is constructed:

$$y_{it} = \alpha + \beta_1 Treat_i + \beta_2 Time + \beta_3 Treat_i \times Time + \beta_4 Control_{it} + \gamma_t + \mu_i + \varepsilon_i \quad (2.1)$$

Among them, the enterprise performance is measured by the Tobin Q value of the enterprise, and y_{it} indicates the performance of the i smes in the t year. $Treat_i$ indicates whether the i SME is the experimental enterprise. If yes, the value is 1; otherwise, it is 0; $Time$ indicates the time of exogenous impact. The value from 2016 to 2019 is 0, and the value from 2020 is 1. The Control variables at the enterprise level are represented by $Control_{it}$. γ_t is the time fixed effect, μ_i is the individual fixed effect, and ε_i is the disturbance term. This paper focuses on the coefficient β_3 of the $Treat_i$ - $Time$ interaction term (DID), which represents the net impact of the COVID-19 impact on business operations. In order to ensure the robustness of the study conclusions, we will extend the sample time from the two periods before and after the outbreak to 2016-2020 respectively.

This paper analyzes the impact of external shocks on the operation of small and medium-sized enterprises through the differential model, and intends to use the triple difference model to explore whether digital inclusive finance has a mitigating effect on the impact faced by small and medium-sized enterprises in China. In the context of the COVID-19 pandemic in China, a large number of bank outlets have been forced to close or reduce their business hours due to the restriction of staff flow, while the "contactless mode" brought by digital inclusive finance has completed various online business processing, and won a lifeline to the cash flow dilemma faced by small and medium-sized enterprises due to the inability to resume work and production in a timely manner.

This paper uses Peking University Digital Financial Inclusion Index (DIF) as explanatory variable to evaluate the regional digital financial inclusion level, and obtains provincial digital financial inclusion index corresponding to the province where the enterprise is registered during the corresponding sample period. The provinces exceeding the national average level are classified as high digital financial inclusion level areas ($DIF_j = 1$), and the cities below the average level are classified as low digital financial inclusion level areas ($DIF_j = 0$). On this basis, a triple difference term $DIF_j \times Treat_i \times Time$ (DDD) was established to verify the mitigation effect of the development of digital financial inclusion on smes' response to the impact of the epidemic. On the basis of formula (2.1), this paper builds the following model:

$$\begin{aligned} y_{ijt} = & \alpha + \beta_1 Treat_i + \beta_2 Time + \beta_3 DIF_j + \beta_4 Treat_i \times Time \\ & + \beta_5 DIF_j \times Treat_i + \beta_6 DIF_j \times Time \\ & + \beta_7 DIF_j \times Treat_i \times Time + \beta_8 Control_{it} + \gamma_t + \mu_i + \varepsilon_i \end{aligned} \quad (2.2)$$

2.2 Data source and variable selection

In order to explore the impact of digital financial inclusion on the performance of smes under the impact of the epidemic, this paper uses the following data.

Considering the impact of the outbreak of COVID-19 on the performance of small and medium-sized enterprises and the moderating role of digital inclusive finance, this paper selects the listed companies on China's New Third Board from 2016 to 2020 as samples, which not only meets the research needs of this paper, but also has a certain degree of real-time and relevance.

The main data include: the digital financial inclusion data used in this paper is the Peking University Digital Financial Inclusion Index compiled by the Digital Finance Research Group of Peking University; The financial data and management structure data of the enterprise are from the Guotai 'an database and the Wande database. In order to ensure the accuracy and consistency of the data, this paper excludes ST, *ST, PT and delisted companies, and excludes the samples listed after June 30, 2020, including the financial industry, companies whose main financial data is less than 5 years old, and companies whose main business income is negative. Indent all continuous variables by 1 and 99 digits and eliminate missing values. Finally, 852 samples of small and medium-sized enterprises that meet the research conditions of this paper are obtained.

The explained variable in this paper is SME performance, which is represented by TobinQ. The grouping dummy variable is Treat, the Time dummy variable is Time, and the regional digital financial inclusion level dummy variable dif. Control variables at the enterprise level include: enterprise asset size (size), which is expressed in the form of logarithm of total assets; age (age); Corporate cash flow (cfo), expressed as net cash flow from operating activities as a percentage of total assets at the end of the period. Table 1 shows the descriptive statistical results of the main variables. We conducted a double-tailed indent treatment for all variables at the 1% level to avoid the influence of outliers on the empirical results.

Table 1. Descriptive statistics of variables

variable	Observed number	Mean	Standard deviation	minimum	maximum
TobinQ	4265	2.065	0.743	0.761	2.591
dif	4265	3.189	0.522	2.004	4.319
difcd	4265	2.979	0.515	1.672	3.970
difud	4265	3.270	0.628	1.727	4.887
difdl	4265	3.733	0.489	2.931	4.622
SA	4265	4.700	1.335	-0.103	13.17
size	4265	22.16	0.723	17.89	28.12
age	4265	2.061	0.557	2	3.833
growth	4265	0.166	0.216	-0.157	0.469

cfo	4265	0.0500	0.0730	-0.670	0.533
Treat	4265	0.847	0.360	0	1

As shown in Table 1, there are 4265 valid samples. After normalization, the maximum value of digital inclusive finance is 4.319, the minimum value is 2.004, the average value is 3.189, and the standard deviation is 0.522. The data show that there are big differences in the development level of digital financial inclusion among regions, which is consistent with the research results of Guo Feng (2019). From the above descriptive statistics, it can be seen that the values of the selected variables are within a relatively appropriate range, without significant abnormal values, and the selected samples meet the requirements of the study.

3.RESULTS AND DISCUSSION

3.1 Impact of COVID-19 on the performance of small and medium-sized enterprises

3.1.1 Parallel trend test

In this paper, the business performance trends of the experimental group and the control group during 2016-2020 were studied using the graphical method (see Figure 1). The horizontal coordinate in Figure 1 refers to time, the left side of the dotted line refers to before the outbreak, and the right side refers to after the outbreak. The ordinate represents the average performance of the group of firms. As can be seen from Figure 1, without being affected by the epidemic, the enterprise performance curves of the experimental group and the control group were almost parallel, indicating that the performance change trend of the two groups was the same. The direct evidence of the common trend hypothesis is obtained, and we can preliminarily speculate the validity of the common trend hypothesis.

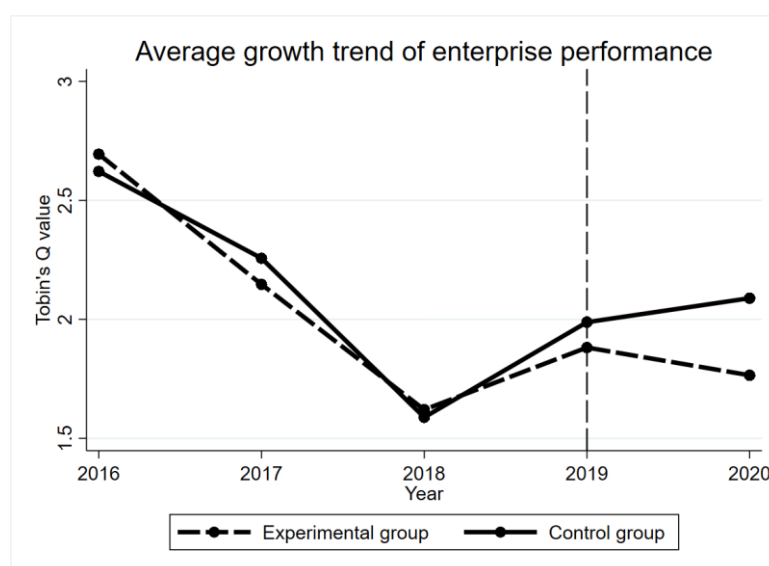


Fig. 1. Visual evidence of common trends between the experimental group and the control group

In order to ensure the unbiasedness of the differential model, this project refers to the research ideas of Jacobson et al. (1993), Chen Zhao and Xiong Ruixiang (2015), Beck et al. (2010) to decompose the dynamic trend of the performance of SMEs affected by the novel coronavirus epidemic, and uses the event analysis method to test the common trend and dynamic effect. First, the interaction term between the time dummy variable and the experimental group dummy variable is generated, taking 2019 as the starting point of the outbreak. For example, pre1 represents 1 year before the outbreak of the epidemic, and post1 represents 1 year after the outbreak of the epidemic. Secondly, the interaction term was brought into the established model as an explanatory variable for regression analysis, and the interaction term coefficient was used to better observe the dynamic and long-term effects of the COVID-19 epidemic. Before the outbreak of COVID-19, the interaction coefficient was not significantly different from 0, indicating that there was no significant difference between the management level of the treatment group and the control group before the impact of the epidemic, and it also proved that they met the common trend hypothesis, that is, the novel coronavirus epidemic has strong exogeneity. The results are shown in Table 2. The results showed that the interaction coefficients before the outbreak were not significant regardless of whether other control variables were added. This can also be seen as a further supplement to the preliminary test of the common trend hypothesis based on characteristic facts in Figure 1, that is, the differential model used is statistically consistent with the common trend hypothesis, so the rationality of using the differential model can be ensured.

Table 2. Parallel trend and dynamic effect test

variable	(1)	(2)	(3)	(4)
	TobinQ a	TobinQ b	TobinQ a	TobinQ b
pre_3×treat	-0.009 (-0.38)	-0.003 (-0.69)	-0.007 (-0.98)	0.004 (-1.03)
pre_2×treat	-0.26 (-0.88)	-0.159 (-0.51)	-0.170 (-0.55)	-0.183 (-0.59)
pre_1×treat	0.428 (1.35)	0.307 (1.00)	0.303 (0.45)	0.304 (0.33)
post_1×treat	-0.020** (-2.53)	-0.018** (-2.47)	-0.017** (-2.68)	-0.021** (-2.85)
Control			YES	YES
Company FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	4146	4146	4146	4146
adj. R2	0.022	0.090	0.108	0.109

Note: *, **, *** indicate significant at the significance level of 10%, 5%, and 1%, respectively

3.1.2 Full sample baseline regression

This paper examines how the development of digital financial inclusion has an impact on the performance of smes in China in the context of the COVID-19 pandemic. The baseline regression results are given in Table 3. Table 3 shows the results of bidirectional fixed empirical analysis of individuals and time. In this paper, TobinQ value, the proxy variable of business activities of small and medium-sized enterprises, is used to measure their profitability. Table 3 (1) and (2) show regression results for the 2019-2020 biennial data. After controlling the characteristic variables of enterprises, the DID coefficient is significantly negative, which indicates that under the influence of COVID-19, the TobinQ value of labor-intensive enterprises decreases by about 5.1% compared with that of other non-labor-intensive enterprises. We extended the time range of the study to 2016-2020 to control the time trend and individual fixed effects. The results shown in columns (3) and (4) of Table 3 show that the core key variable of the differentially differential model is significantly negative. Through the above research, it is found that compared with the control group, the outbreak of the epidemic has a relatively greater negative impact on the performance of small and medium-sized enterprises in the experimental group. Although smes have played a pivotal role in China's development process, they are the most affected in the face of sudden major public crises, especially for those small and medium-sized enterprises with low technical level, at the bottom of the industrial chain, and limited sources of capital, coupled with intensive personnel increases the cost of epidemic prevention. Making their performance in this crisis even worse.

Table 3. Impact of the epidemic on the business activities of small and medium-sized enterprises

variable	(1) TobinQ a	(2) TobinQ b	(3) TobinQ a	(4) TobinQ b
DID	-0.051** (-2.03)	-0.075** (-2.04)	-0.051** (-2.10)	-0.075** (-2.14)
Time	-0.007 (-0.37)	-0.009 (-0.62)		
size	-0.603* (-2.58)	-0.601* (-2.73)	-0.097** (-2.43)	-0.021** (-2.51)
age			0.048** (2.18)	0.046** (2.05)
growth	0.046** (2.08)	0.058** (2.21)	0.129** (2.10)	0.106** (2.07)
cfo	0.029 (1.08)	0.032 (1.36)	0.181 (0.18)	0.150 (0.31)
CompanyFE	YES	YES	YES	YES
Year FE			YES	YES
N	4146	4146	4146	4146

adj. R^2	0.091	0.109	0.107	0.108
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Note: *, **, *** indicate significant at the significance level of 10%, 5%, and 1%, respectively

In general, the COVID-19 pandemic has hindered the improvement of the overall business performance of Chinese smes. This has caused the problem of "financing difficulties" of small and medium-sized enterprises to a large extent. Based on the above analysis, characteristic facts, empirical evidence and existing literature, this paper concludes that the COVID-19 epidemic has a more significant impact on labor-intensive smes, increasing their difficulties in resuming work and financing, and gradually decreasing their business conditions.

3.2 The mitigation effect of digital financial inclusion on the impact of the epidemic

Focusing on the theme of the impact of the novel coronavirus pneumonia epidemic on small and medium-sized enterprises in China, this paper conducts an in-depth analysis of the role of digital inclusive finance in the business activities of small and medium-sized enterprises in China, and establishes a triple difference model to investigate whether digital inclusive finance has alleviated the impact on small and medium-sized enterprises in the context of the novel coronavirus epidemic. The regression results are shown in Table 4.

Table 4. The mitigating effect of financial development on negative shocks of digital inclusive finance

variable	(1)	(2)	(3)	(4)
	TobinQ a	TobinQ b	TobinQ a	TobinQ b
DDD	0.231** (2.87)	0.249** (2.65)	0.243*** (2.82)	0.246*** (4.87)
DID	-0.260*** (-3.72)	-0.219*** (-2.55)	-0.270*** (-2.72)	-0.176*** (-6.75)
Time	-0.187 (-0.82)	-0.784 (-1.71)		
dif	0.292*** (2.15)	0.307*** (2.35)	-0.282*** (-2.18)	-0.276*** (-2.11)
dif×time	-0.853 (-1.39)	-0.769 (-1.30)	-0.768 (-1.31)	-0.776 (-1.32)
dif×treat	-0.063*** (-8.07)	-0.060*** (-6.69)	-0.057*** (-7.60)	-0.056*** (-9.57)
Control	YES	YES	YES	YES
Company FE	YES	YES	YES	YES
Year FE			YES	YES
N	4146	4146	4146	4146
adj. R^2	0.024	0.091	0.110	0.108

The table above shows the role of digital financial inclusion, estimated using the triple difference algorithm, in mitigating the adverse effects of the pandemic shock. Through the

results of 2019-2020, it is found that the coefficient of DDD item is positive, which indicates that the development of digital inclusive finance can reduce the adverse impact caused by the epidemic, effectively improve the operating profit of enterprises, and make the company's operating conditions significantly improved. Even if we change this window to 2016-2020, this conclusion is true.

3.3 Placebo test

The robustness of the results of this paper was proved by adjusting the time window previously. In order to further test whether the above results would be affected by missing variables and random factors, this paper conducted placebo test by changing the outbreak time of the epidemic and randomly defining the treatment group and the control group.

3.3.1 Change the timing of the outbreak

In the previous study, this paper adopted methods such as adjusting the time range to verify the robustness of the conclusions, and on this basis, whether there are missing variables and other random factors in the triple difference model is considered. Different outbreak times will be used in this paper to verify the robustness of the conclusions. Based on the study by Zhihua Zhao and Jiannan Wu (2020), a placebo test was used to eliminate the interference of this effect. We advance the outbreak to 2019, 2018 and 2017, and create dummy variables time2019, time2018 and time2017, respectively, to test the impact of the outbreak on the business activities of smes and the mitigation effect of the development of digital financial inclusion on smes. Table 5 shows the specific regression results.

Table 5. Placebo test results (change outbreak time)

variable	(1) TobinQ	(2) TobinQ	(3) TobinQ
difxtreatxtime2017	-0.009 (-0.70)		-0.004 (-0.62)
treatxtime2017	0.009 (0.76)		0.002 (0.16)
difxtreatxtime2018	-0.006 (-0.47)		-0.008 (-0.78)
treatxtime2018	-0.035 (-0.29)		-0.032 (-0.19)
difxtreatxtime2019	-0.003 (-0.17)	-0.004 (-0.22)	
treatxtime2019	0.003 (0.37)	0.002 (0.17)	
Control	YES	YES	YES
Company FE	YES	YES	YES
Year FE	YES	YES	YES
N	4178	4178	4178

adj. R^2	0.050	0.051	0.055
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From the data analysis in Table 5, it can be found that the impact of the epidemic in other assumed years has no significant impact on the performance of smes, and the triple-difference variable formed by it and the development of digital inclusive finance is also not significant, indicating that the above regression results are less affected by the inherent differences between the control group and the control group and unobstructed factors. The results of regression analysis are robust.

3.3.2 Randomly define processing groups and control groups

In this paper, the sample enterprises are randomly divided, and the corresponding differential model and triple difference model are constructed. Based on the fixed effect model mentioned above, the regression analysis is carried out, and the estimated value of the corresponding differential variable coefficient is obtained. In this paper, the above process is repeated for 1000 times. Figure 2 shows the distribution of the estimated values of the DID and DDD coefficients of the triple difference cross-multiplying terms in the 1000 estimates.

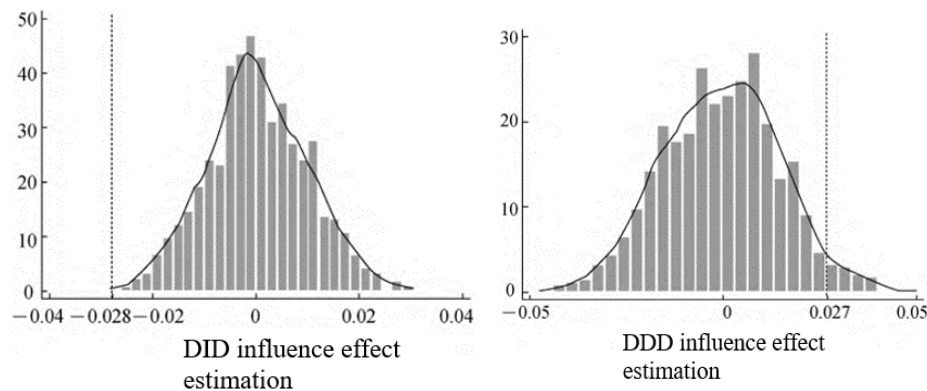


Fig. 2. DID and DDD coefficient distributions in randomization

As can be seen from the results in the chart, the probability that the parameter estimates obtained through the virtual grouping are greater than the regression results of the real grouping is very low. Basically, 0 is the average value and the distribution is normal. Therefore, it can be inferred that the above empirical results are not caused by some unobtainable other factors, which can better explain the reliability of the conclusions.

4. CONCLUSION

In the Spring Festival of 2020, the sudden outbreak of COVID-19 not only brought a great threat to people's life and safety, but also caused a huge impact on China's social and economic development. This paper intends to take listed enterprises on the New Third Board as samples to conduct a systematic empirical test on the impact of COVID-19 on enterprise performance from two aspects of overall and industry heterogeneity, and further test the specific role of digital inclusive finance in the impact of COVID-19 on the performance of small and medium-sized

enterprises. Finally, the following conclusions are drawn:

First, the COVID-19 epidemic has a certain negative effect on corporate performance, which has different industry characteristics, especially the negative impact on service and small and medium-sized companies. The transmission path of COVID-19 on corporate performance is "COVID-19 -- a series of closed policies -- continuous impact (on people) -- macroeconomic effect -- microeconomic effect -- corporate performance". When the epidemic broke out, it was difficult for enterprises to resume work due to the implementation of closed policies. As a result, enterprise labor shortage, productivity reduction, household consumption reduction, and then the income of enterprises will be reduced, and finally the capital flow of enterprises will become more tense, which will affect the daily operation of enterprises and impact the performance of enterprises.

Second, the moderating effect of digital financial inclusion can reduce the negative impact of COVID-19 on corporate performance, especially for small and medium-sized enterprises. Combined with mobile Internet, big data and other technologies, digital inclusive finance can dig deep into the inter-bank business data, and combined with the characteristics of customer business, control the bank loan business at a lower cost, and facilitate the credit department to achieve low-cost control. Based on digital technology and big data, digital inclusive finance has established a more complete credit evaluation system, thus promoting a fair and transparent financing environment. At the same time, the use of digital inclusive finance can provide enterprises with diversified, specialized and precise financial services and products, simplify the financing process of enterprises, reduce the financing cost of enterprises, improve the efficiency of capital use of enterprises, and reduce the current financial pressure of small and medium-sized enterprises. The digital inclusive finance represented by mobile payment can help customers conduct online transactions, investment and financing, reduce the agglomeration of personnel, and increase the income and performance of enterprises without large-scale infection.

Third, the impact of digital financial inclusion on SME performance is significantly heterogeneous. In the second-level segmentation index, the coefficients of the two variables of digital financial inclusion coverage and depth of use are significantly positive, and the increase of coverage coverage and depth of use improves the performance of smes. Compared with state-owned enterprises, digital inclusive finance plays a significantly higher role in promoting them than non-state-owned enterprises. The main reason for this phenomenon is that state-owned enterprises have the advantages of state protection and easier access to capital.

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