**Ethan Journal of Business Administration and Management**
ISSN: 2997-3147 |
Volume 10 Issue 3, July- September, 2022
Journal Homepage: https://ethanpub.online/Journals/index.php/E39
Official Journal of Ethan Publication

# INNOVATIVE SOLUTIONS: LEVERAGING DIGITAL FINANCE TO ADVANCE SMES' FINANCING AND EQUITY

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**Abstract**
*The issue of financing constraints has long plagued small and medium-sized enterprises (SMEs), despite their significant contributions to China's economy, as highlighted in the 2021 China SME Financing Development Report. These SMEs account for a substantial portion of GDP, employment, market share, and tax revenue. Nonetheless, financing constraints persist, particularly in the context of equity financing. Zhang et al. (2021) have noted that listed companies in China face varying degrees of financial and equity financing constraints, significantly impeding their further growth. This phenomenon stems from multiple factors.*
*One key challenge arises from the fact that many micro, small, and medium-sized enterprises in China fail to meet the stringent listing standards, restricting their access to equity financing and, consequently, hindering their development. Additionally, investors, when considering equity financing, tend to favor larger enterprises and established stocks due to the relatively lower information transparency and uncertain growth prospects associated with micro, small, and medium-sized enterprises. This preference further exacerbates the financing challenges faced by SMEs. This paper delves into the multifaceted nature of SME financing constraints in China, shedding light on the complexities of the issue and proposing potential solutions to empower the continued growth and development of these critical economic actors.*

**Keywords:** : SME Financing, Financing Constraints, Equity Financing, Small and Medium-sized Enterprises, China's Economic Development

## 1. Introduction

Sme financing constraints have always existed. According to the 2021 China SME Financing Development Report, smes account for more than 60% of GDP, 79.4% of employment, 95% of the market, and more than 50% of tax payments. The role of smes in China's economic development is beyond doubt.

However, the problem of financing constraints is widespread. Zhang et al. (2021)[9]believes that listed companies in China are faced with different degrees of financing constraints and equity financing constraints, which seriously restrict the further development of enterprises. There are many reasons for this situation. On the one hand, due to their own enterprise management level and development ability has not yet reached the listing standards, many micro, small and medium-sized enterprises in our country cannot be listed through equity financing, which seriously restricts the further development of micro, small and medium-sized enterprises; On the other hand, for investors who tend to carry out equity financing, due to the low information transparency and uncertain development prospects of micro, small and medium-sized enterprises, investors prefer large enterprises and white horse stocks compared with micro, small and medium-sized enterprises in the stock market.

In recent years, thanks to the in-depth development of a new round of Internet technological revolution and industrial transformation, China's digital economy has made rapid progress and become an important driving force

for high-quality economic development. According to the latest "White Paper on China's Digital Economy Development (2021)" report released by the China Academy of Information and Communications Technology: In 2020, the scale of China's digital economy reached 39.2 trillion yuan, an increase of 3.3 trillion yuan over last year, accounting for 38.6% of GDP, an increase of 2.4 percentage points year-on-year, effectively supporting epidemic prevention and control and economic and social development. It is expected that by 2022, the scale of digital economy will increase to 48.9 trillion yuan.

Therefore, based on the data of listed smes from 2014 to 2020 and the China Digital Financial Inclusion Index of the Digital Finance Research Center of Peking University, this paper applies the fixedeffect model, spatial Durbin model and intermediary effect method, and from the perspective of innovation of micro, small and medium-sized enterprises, This paper empirically tests whether digital finance can effectively alleviate the overall financing constraints and equity financing constraints of micro, small and medium-sized enterprises. The empirical research finds that digital finance can significantly alleviate the overall financing constraints and equity financing constraints of micro, small and medium-sized enterprises. Further in-depth research confirms that due to the existing economic barriers and siphon effect, digital finance has a positive spillover effect on financing constraints. The results show that, on the one hand, enterprise innovation is an important channel for digital finance to have an impact on overall financing constraints, but it is not an important channel for equity financing constraints. On the other hand, the intervention of spatial effect will weaken the original influence mechanism.

The academic contributions of this paper are mainly reflected in the following aspects: First, there are many historical literatures studying the impact of digital finance on the financing constraints of enterprises, but the historical literatures mainly study the overall financing constraints of enterprises, and few literatures study the impact of digital finance from the perspective of equity financing constraints. Secondly, the spatial Durbin model is used to study the easing effect of digital finance on the financing constraints of micro, small and medium-sized enterprises and the influencing mechanism.

The rest of this paper is structured as follows: The second part summarizes the relevant literature of digital finance, analyzes the mechanism of digital finance's influence on the equity financing constraints of small and micro enterprises, and puts forward research hypotheses; The third part is the traditional measurement model design, variable selection and data description. The fourth part is the result of baseline regression. The fifth part is endogeneity test and robustness test, so as to ensure the reliability and robustness of the research results of this paper; The sixth part is the influence channel test based on the traditional econometric model and the spatial Durbin model. The seventh part is conclusion and suggestion.

## 2. Literature Review and Research Hypothesis

In the current research, most scholars propose that digital finance can significantly alleviate financing constraints through empirical tests. For example, Lu et al. (2022)[14] found that the financing constraints of smes are negatively correlated with the proportion of local bank outlets and the degree of digital financial inclusion, and local bank outlets and digital financial inclusion have a substitution effect on alleviating the financing constraints of smes. Wang (2022) [15]empirically found that financing constraints are the mechanism by which digital finance reduces corporate financial risks. Yao and Yang(2022) [16]empirically tested that digital finance has a significant positive impact on smes' innovation and incentive innovation through the path of easing financing constraints through two-way fixed effect model and intermediary effect model. Yang et al. (2021)[19] found that digital finance can promote the innovative development of private enterprises on GEM by easing financing constraints. Ma et al. (2021)[20] research shows that the development of digital finance significantly inhibits the enterprise exit probability. However, according to the theory of information ecology, some scholars believe that whether smes obtain funds from traditional financial institutions such as banks or related institutions of digital finance, they will have the problem of mismatching of investment and financing term, and believe that enterprises will have the risk of "short loan and long investment". For example, Jike and Zhang (2021) [8]empirically tested that the development of digital finance would

aggravate the maturity mismatch of enterprises' investment and financing by introducing the intermediate variable of the current increment of short-term credit. At the same time, Yu(2015)[7] explored the influencing factors of investment and financing term mismatch from the perspective of the characteristics of enterprises themselves, and found that the higher the degree of financing constraint, the higher the degree of investment and financing term mismatch.

In summary, from the perspectives of information asymmetry, transaction cost theory and dynamic capability theory, the development of digital finance is conducive to solving the problem of information asymmetry and alleviating financing constraints. However, from the perspective of maturity mismatch, information ecology theory and rational man hypothesis, the development of digital finance has exacerbated the financing maturity mismatch of smes, which is not conducive to easing financing constraints. Based on the contradictions generated by the above theories, this paper proposes the research hypothesis:

**H1:** Digital financial inclusion can reduce the overall financing constraints of micro, small and medium-sized enterprises and equity financing constraints.

The existing literature finds that digital inclusive finance, as a digital economic technology formed based on the Internet, significantly affects the process of technological innovation, transformation and upgrading of smes, and ultimately helps to alleviate financing constraints. Further tests confirm that the impact is heterogeneous. Li and Li (2022)[17] estimated the net effect of digital financial inclusion on urban innovation by using differential model, and their research results showed that digital financial inclusion had a positive impact on urban innovation. In addition, digital financial inclusion could promote urban innovation by improving credit resource allocation, consumption and industrial upgrading. Li et al. (2021)[18] found through empirical research that the development level of digital finance is significantly positively correlated with the investment in innovation of enterprises, and digital finance promotes the investment in innovation of enterprises partly by influencing the equity pledge of controlling shareholders. Highly innovative firms face unique financing constraints because there is often a greater degree of information asymmetry between firms and potential lenders (Sahar&Rebecca, 2022)[11]. In addition, Yao and Yang (2022)[16] confirmed through empirical research that the development of digital finance significantly stimulates the innovation of micro, small and medium-sized enterprises, and influences the channels to ease financing constraints. However, Han and Gu (2021) [12] investigated DFIIC (Digital Finance Index) from two aspects: coverage breadth and use depth, and found that the use depth had no significant effect on the promotion of innovation performance. In view of the contradictory conclusions in the research, this paper proposes the following hypotheses:

**H2:** Digital inclusive finance influences the equity financing constraints of micro, small and mediumsized enterprises through enterprise innovation.

From the perspective of spatial correlation, digital inclusive finance has a spatial spillover effect on neighboring provinces. Digital financial inclusion can significantly promote the growth of farmers' income, which has a positive spatial spillover effect. Farmers' income growth increases with the development of digital financial inclusion, and the impact of digital financial inclusion on farmers' income growth is heterogeneous at the provincial level of economic development (Li et al., 2022)[10]. However, Li et al. (2022) [13]empirically tested the negative spatial spillover effect of the development of digital finance on the surrounding areas through the spatial econometric model: when the level of digital inclusive finance in the surrounding provinces increases by 1%, the consumption of local residents will decrease by 0.1289%. Therefore, examining whether digital finance has spatial spillover effect is a key empirical test of this paper. Based on the above, this paper proposes a third research hypothesis:

**H3:** Digital inclusive finance has a positive spatial spillover effect on neighboring provinces.

## 3. Model design, Variable Selection and Data Explanation

### *3.1.* Model Design

According to the micro survey data and the data published by wind and Guotai 'an, the benchmark model of this paper is preliminarily set as follows:

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Volume 10 Issue 3, July- September, 2022
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$$Y = \beta_0 + \beta_1 DIF + \sum \varphi CV + \mu_{it} + u \quad (1)$$

Y is the financing constraint of smes, DIF is the digital financial index, CV is the control variable group, μ_it is the individual fixed effect, and u represents the random error term.

### *3.2.* Variable Selection

#### *3.2.1.* Interpreted variable

Financing constraint index: Refer to Wei Zhihua et al. (2014)[4]. The specific calculation method of the index is as follows:

$$KZ = -1.001909 * OCF/Asset + 3.139193 * Lev - 39.3678 * Dividends/Asset - 1.314759 * \frac{Cash}{Asset} + 0.2826389 * Tobin'sQ \quad (2)$$

OCF, Dividends and Cash refer to the net operating cash flow, dividends and cash holding levels, respectively, and are standardized by total assets at the beginning of the period. Lev refers to the assetliability ratio, and Tobin's Q refers to Tobin's Q value. The larger the value, the higher the degree of financing constraints faced by the enterprise.

Equity financing constraints: In the process of studying equity financing constraints, this paper draws on the studies of Yu Zhen, Zhou Lei (2022)[2], Shi Jikun et al. (2011)[5], and establishes the core explained variable of equity financing cost of smes through the construction of PEG model.

#### *3.2.2.* Explanatory Variable

DIF for Digital Finance - This paper uses the provincial index of Digital Financial Inclusion of Peking University's Digital Finance Research Center as the core explanatory variable of the model.

#### *3.2.3.* Control Variable

With reference to existing literatures, this paper selects CV as the control variables that affect the financing of smes, including financial development level, regional economic growth rate, social financing scale growth rate, industrial enterprise sales growth rate and other indicators.

#### *3.2.4.* Intermediate Variable

Enterprise innovation is selected as the intermediary variable, and the proportion of business income invested in R&D is taken as the measure of enterprise innovation intensity.

### *3.3.* Data

The research object of this paper is the small and medium-sized enterprises listed on Shenzhen Stock Exchange in China. The sample period is 2014-2020. The social financing data comes from the official website of the National Bureau of Statistics, and the digital finance index comes from the Beijing University Digital Inclusive Finance Index jointly compiled by the Digital Finance Research Center of Peking University and Ant Technology Group. The financing ability of small and micro enterprises and other control variables are all derived from Wind database. According to the practices of Yu et al. (2019)[6], the data were screened as follows: (1) Data of listed financial companies were excluded; (2) The data of company establishment from 2014 to 2018 are excluded; (3) Remove *ST, ST, PT companies; (4) Companies with asset-liability ratio greater than 1 and less than 0 are excluded; (5) Eliminate companies with negative owners' equity; (6)Eliminate CF, capital expenditure absolute value greater than 1 companies; (7)Eliminate the missing company data in the middle year of key indicators to ensure the continuity of company data; (8)If the company name is the same but the company code is different or the company code is the same but the company name is different, it is identified according to the basic information such as the province where the company's public address is located, postal code, etc. If it is the same company, it is eliminated; (9) Major variables were treated with Winsor less than 1% and more than 99%. Finally, the data of 1904 balanced panels were obtained. Descriptive statistics are shown in Table 1.

Table 1: Descriptive statistics of main variables

| variable | number | Mean | sd | min | max |
|---|---|---|---|---|---|
| Equity financing constraints | 1,904 | -0.005 | 0.031 | -0.485 | 0.336 |

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| | | | | | |
|---|---|---|---|---|---|
| Digital finance index | 1,904 | 5.529 | 0.194 | 4.969 | 5.934 |
| Depth Index | 1,904 | 5.457 | 0.2 | 4.842 | 5.869 |
| Breadth index | 1,904 | 5.494 | 0.269 | 4.676 | 5.992 |

Table 1 is descriptive statistics. It is found in this paper that the average value of equity financing constraints is -0.005, the maximum value is 0.336, and the minimum value is -0.485. The greater the equity financing constraints index, the tighter the equity financing constraints companies face. It can be seen that most small and medium-sized enterprises are faced with tight constraints with negative financing constraints, which will not help small and medium-sized enterprises to carry out equity financing through the capital market, thus hindering their further development. The standard deviations of index aggregate, coverage breadth and usage depth of digital finance are 0.194, 0.2 and 0.269, respectively. It shows that the development degree of digital finance in different regions of our country is quite different.

## 4. Results and Analysis

### *4.1.* Construction of Equity Financing Constraints

According to relevant literature, domestic scholars took dividend payout ratio (a univariate indicator with more emphasis on equity financing) as a proxy variable for equity financing constraints to study equity financing constraints of listed companies in China. Yu Zhen and Zhou Lei (2022)[2] measured the cost of corporate equity financing through PEG model and found in their empirical research that, Digital finance can significantly reduce the cost of corporate equity financing, and the effect is more significant in small-scale enterprises.

Based on the above analysis, this paper draws on the studies of Yu Zhen, Zhou Lei (2022)[2], Shi Jikun et al. (2011)[5], and establishes the core explained variable of equity financing cost of smes through the construction of PEG model.

### *4.2.* Reference Regression

In Table 2, this paper designs three different models to consider the impact of digital finance on equity financing of smes from three different dimensions: total digital finance index, depth of digital finance index and breadth of digital finance index. It can be seen from column (1) of Table 2 that when total digital finance index is the core explanatory variable, the coefficient of digital finance index is -0.0121. This coefficient has passed the significance level test of 5%, that is to say, each increase of one unit of the total digital finance index reduces the financing constraints faced by smes by 0.0121, thus verifying the hypothesis that digital finance can effectively reduce the equity financing constraints of smes from an empirical point of view. Hypothesis H1 is confirmed. In addition, columns (2) and (3) in Table 2 take digital financial depth index and digital financial breadth index as core explanatory variables, and their coefficients are -0.0110 and -0.0102 respectively, passing the significance level test of 10% and 5% respectively. From the absolute value of these two coefficients, Compared with the breadth index, the depth index of digital finance is easier to relax financing constraints, that is, with the continuous penetration of digital finance into enterprises, it is more conducive to enterprises to obtain financing, which is conducive to enterprises to improve their production and operation. In Table 3, the impact of digital finance on the overall financing of smes is considered from three different dimensions, namely the total digital finance index, the depth of digital finance index and the breadth of digital finance index, and the conclusions are consistent with those in Table 2.

Table 2: Regression results of equity financing cost

| variable | (1) | (2) | (3) |
|---|---|---|---|
| Digital finance index | -0.0121** | | |
| | (-2.69) | | |
| Depth Index | | -0.0110* | |
| | | (-2.56) | |
| Breadth index | | | -0.0102** |
| | | | (-3.25) |

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Volume 10 Issue 3, July- September, 2022
Journal Homepage: https://ethanpub.online/Journals/index.php/E39
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| | | | |
|---|---|---|---|
| Constant | 0.0496 | 0.0426 | 0.0389 |
| | (1.59) | (1.37) | (1.71) |
| Control variable | YES | YES | YES |
| Individual fixation effect | YES | YES | YES |
| Sample | 1904 | 1904 | 1904 |
| $R^2$ | 0.019 | 0.019 | 0.021 |

Note: "*", "**", and "***" indicate significant at the significance level of 10%, 5%, and 1%, respectively, with t statistics in brackets. The rest table is the same.

Table 3: Regression results of overall financing constraints

| variable | (1) | (2) | (3) |
|---|---|---|---|
| | Digital finance index | Depth Index | Breadth index |
| Digital finance index | -0.339** | | |
| | (-2.94) | | |
| Depth Index | | -0.405*** | |
| | | (-3.56) | |
| Breadth index | | | -0.331*** |
| | | | (-3.75) |
| Constant | 1.609* | 1.982** | 1.569** |
| | (2.15) | (2.70) | (2.63) |
| Control variable | YES | YES | YES |
| Individual fixation effect | YES | YES | YES |
| Sample | 1904 | 1904 | 1904 |
| $R^2$ | 0.329 | 0.330 | 0.330 |

## 5. Endogenetic Treatment and Robustness Test

In order to make the research results more reliable, this paper uses the method of instrumental variables and removes the influence of some factors to do endogenous processing and robustness test of the model.

### *5.1.* Instrumental Variable Method

Due to the endogeneity problem caused by missing variables, appropriate instrumental variables will be selected for the core explanatory variables. In this paper, based on the research of Tang Song et al. (2020)[3], mobile phone penetration rate is used as the instrumental variable of digital finance. According to the results in Table 4, after the use of instrumental variables, the results are still significant at the significance level of 5%. According to the results in Table 5, the results show that the partial R square is =0.646, indicating that the instrumental variable mobile phone penetration rate has a strong explanatory power on the endogenous variable digital finance index. In addition, according to statistics F =11.476>10, It can be seen that the instrumental variable in this paper is not a weak instrumental variable, which further verifies the reliability of the model results.

Table 4: Regression results of instrumental variables

| Equity financing constraints | Regression coefficient | Standard error | T-value | P-value | [95%Conf Interval] | Sig |
|---|---|---|---|---|---|---|

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Volume 10 Issue 3, July- September, 2022
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|---|---|---|---|---|---|---|---|
| Digital finance index | -.025 | .011 | -2.38 | .017 | -.046 | -.004 | ** |
| Constant | .147 | .065 | 2.25 | .024 | .019 | .276 | ** |
| Mean dependent variable | -0.005 | Standard deviation of dependent variable | | | | 0.031 | |
| $R^2$ | 0.042 | Sample | | | | 1904 | |
| chi-square | 38883.288 | Prob>chi2 | | | | 0.000 | |

Table 5: Robustness results of instrumental variables

| variable | $R^2$ | Adjusted $R^2$ | Partial $R^2$ | RobustF(1,30) | Prob>F |
|---|---|---|---|---|---|
| Digital finance index | 0.646 | 0.638 | 0.246 | 11.476 | 0.002 |
| 2SLS relative deviation | | 5% | 10% | 20% | 30% |
| | | 10% | 15% | 20% | 25% |
| 2sls size of nominal 5% wald test | | 8.960 | 6.660 | 5.530 | 8.960 |
| LIML size of nominal 5% wald test | | 8.960 | 6.660 | 5.530 | 8.960 |

### *5.2.* Remove the Influence of Some Factors

Financing behavior is affected by the overall financial situation (financial shock), so this paper excludes some typical financial event shocks, such as the stock market crash in 2015 and the impact of the COVID-19 epidemic in 2020. According to the results in Table 6, after removing the samples from 2015 and 2020, the coefficient of the digital finance index is still negative and has passed the significance level test of 5%, 10% and 5% respectively, which is consistent with the above results and further proves the reliability of the empirical results.

Table 6: Regression results excluding some factors

| variable | (1) | (2) | (3) |
|---|---|---|---|
| Digital finance index | -0.0126** | | |
| | (-2.61) | | |
| Depth Index | | -0.0111* | |
| | | (-2.37) | |
| Breadth index | | | -0.0101** |
| | | | (-2.95) |
| Constant | 0.0513 | 0.0418 | 0.0368 |
| | -1.51 | -1.22 | -1.47 |
| Control variable | YES | YES | YES |
| Individual fixation effect | YES | YES | YES |
| Sample | 1682 | 1682 | 1682 |
| $R^2$ | 0.02 | 0.019 | 0.021 |

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Volume 10 Issue 3, July- September, 2022
Journal Homepage: https://ethanpub.online/Journals/index.php/E39
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## 6. Intermediary Mechanism

Following the research method proposed by Wang Huan (2022)[1], this paper establishes an intermediary effect model to test the mechanism of digital inclusive finance's constraints on equity financing of micro, small and medium-sized enterprises, and constructs the following intermediary variable model:

$$M_{id} = \gamma_0 + \rho_1 \text{lindex} + \theta \text{ Controls}_{ij} + \varepsilon_{it} \quad (3)$$

(4) Equity financing constraints = $\rho_0 + \rho_2$lindex + $\rho_3 M_i + \omega$ Controls $_i + \varepsilon_{it}$

M refers to the intermediary variable, lindex refers to the core explanatory variable number total financial inclusion index, "Controls" represents the set of control variables, and ε represents the random error term.

### *6.1.* Based on Spatial Spillover Mediation Effect Test

#### *6.1.1.* Moran Test

Before carrying out empirical analysis on spatial measurement, it is necessary to study whether the explained variable has spatial spillover effect. The formula of global Moran test is as follows:

$$\text{Moran's I} = \frac{\sum_{i=1}\sum_{j=1} w_{ij}(x_i-\bar{x})(x_j-\bar{x})}{s^2 \sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}} \quad (5)$$

Where i and j are regional names, expressed as province i and province j respectively in the subject; The numerator is the variance of the sample observations, n is the number of provinces in our country, and W is the spatial weight matrix.

In order to confirm the existence of the spatial effect, based on the data of the total index of digital inclusive finance of smes in 31 provinces and cities in China from 2016 to 2020, specific values were calculated using Stata16.0 under the adjacency matrix and economic distance matrix respectively. The empirical results passed the test and were highly similar. In order to simplify the space, only the results based on the economic distance matrix are shown below, and the global Moran empirical results are shown in Table 7.

Table 7: Moran test

| YEAR | I | z | p-value* |
|---|---|---|---|
| 2016 | 0.690 | 4.639 | 0.000 |
| 2017 | 0.698 | 4.703 | 0.000 |
| 2018 | 0.704 | 4.708 | 0.000 |
| 2019 | 0.715 | 4.772 | 0.000 |
| 2020 | 0.727 | 4.840 | 0.000 |

It has been observed that the total index of digital inclusive finance shows an increasing trend in the global Moran index under the economic distance matrix, and the spatial correlation is gradually enhanced, and all are significant at the level of 1%, indicating that the spatial correlation of digital inclusive finance in various provinces in China is becoming stronger and stronger. Therefore, the spatial effect cannot be ignored, and it is reasonable to use the spatial econometric model to analyze it.

In order to test the spatial correlation of explanatory variables at the micro level, this paper will conduct a partial Moran test on the total index of digital inclusive finance of micro, small and mediumsized enterprises in 31 provinces and cities in China. To simplify the space, only the results of 2020 based on the economic distance matrix are shown, as shown in Figure 1. Secondly, ArcMAP software was applied to further describe the distribution of aggregation types in various provinces in China according to the results of Figure 1.

It can be seen from Figure 1 that there is an imbalance in the development of digital inclusive finance among provinces and cities in China. Corresponding to the overall Moran test, the local Moran test also confirmed the spatial correlation of digital financial inclusion, so this paper can choose a spatial econometric model to study the spatial spillover effect of regional digital economy.

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ISSN: 2997-3147 |
Volume 10 Issue 3, July- September, 2022
Journal Homepage: https://ethanpub.online/Journals/index.php/E39
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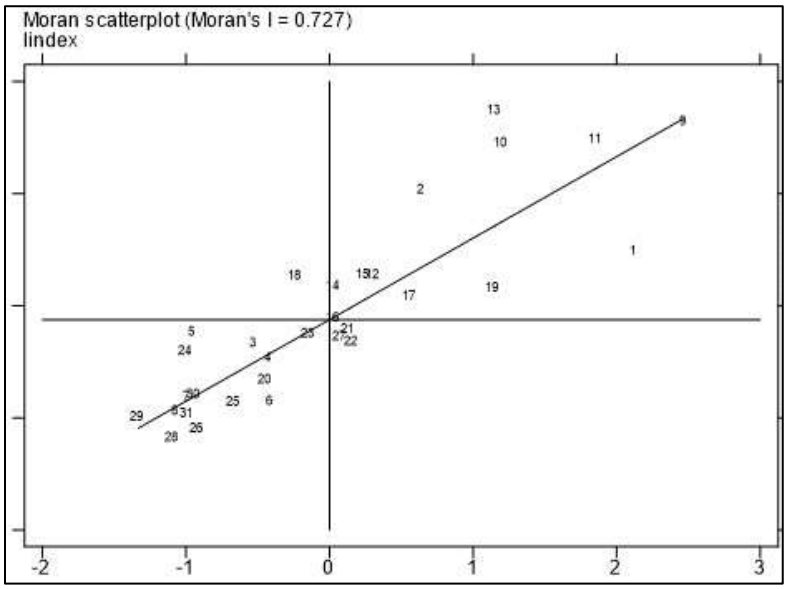


*Figure 1: Local Moran scatter plot*

### *6.1.2.* Spatial Spillover Mediation Effect Test Based on Spatial Durbin Model

By constructing the model space Durbin model (6) and (7), we verify whether the mechanism of digital finance affecting the financing constraints of enterprises through intermediary variables is still valid. Model (6) verifies the impact of digital finance on corporate financing constraints under spatial effects, and model (7) verifies the impact of digital finance on intermediary variables under spatial effects.

$$Y = \alpha + \rho WY + \beta_1 lindex + \beta_2 CV + \theta_1 Wlindex + \theta_2 WCV + \mu_{it} + \varepsilon_{it} \quad (6)$$

$$G = \alpha + \rho WG + \beta_1 lindex + \beta_2 CV + \theta_1 Wlindex + \theta_2 WCV + \mu_{it} + \varepsilon_{it} \quad (7)$$

Y is the financing constraint, lindex is the core explanatory variable of digital finance, G is the intermediary variable, CV is the control variable set mentioned above, and W means the economic distance matrix of order 31*31. ρ refers to the spatial interaction between local financing constraints and neighboring provinces' financing constraints. α is a constant and μ_it is a time-fixed effect. ε_it is the error term. If the estimated coefficients of the core explanatory variables in equations (6) and (7) are significant, the significance test is passed, and the intermediary effect is established. Table 8: Tests based on spatial Durbin model

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| variable | no | yes | no | yes | no | yes |
| finance index | 0.012 | 0.011 | 0.012 | -0.052 | 0.023 | 0.001 |
| | (0.84) | (0.87) | (0.85) | (0.45) | (0.73) | (0.99) |
| Fixed assets | 0.000 | -0.000 | 0.000 | 0.002** | 0.000 | 0.001 |
| | (0.88) | (0.85) | (0.65) | (0.03) | (0.46) | (0.12) |
| Financial cost | 0.249 | 0.010 | | | | |
| | (0.45) | (0.99) | | | | |
| Innovation | | | 0.001 | 0.010** | | |
| | | | (0.64) | (0.02) | | |
| Competition | | | | | 0.000 | 0.000 |
| | | | | | (0.33) | (0.11) |

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ISSN: 2997-3147 |
Volume 10 Issue 3, July- September, 2022
Journal Homepage: https://ethanpub.online/Journals/index.php/E39
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| | | | | | | |
|---|---|---|---|---|---|---|
| Fixed assets * Financial cost | | 0.011 | | | | |
| | | (0.64) | | | | |
| Fixed assets * Innovation | | | | -0.001** | | |
| | | | | (0.02) | | |
| Fixed assets * Competition | | | | | | -0.000 |
| | | | | | | (0.16) |
| Control | YES | YES | YES | YES | YES | YES |

Note: "yes" stands for interaction, "no" stands for noninteraction

The role test of the intermediary variables based on the spatial Durbin model is shown in Table 8 and 9. Columns (1) and (2) examine the combined effect of fixed asset ratio and financial cost; Columns (3) and (4) examine the joint effect of fixed assets ratio and firm innovation; The last two columns examine the interaction between the ratio of fixed assets and the degree of competition of financial institutions. In the continuation table, columns (7) and (8) examine the combined effect of financial cost and firm innovation; Columns (9) and (10) examine the interaction between financial costs and the degree of competition of financial institutions; Columns (11) and (12) examine the interaction between firm innovation and financial institution competition. Through observation, only the interaction terms of fixed assets ratio and enterprise innovation, enterprise innovation and financial institution competition are significant in the empirical results, and play a common role in corporate financing constraints. Table 9: Joint action test based on spatial Durbin model (continued table)

| | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|
| variable | no | yes | no | yes | no | yes |
| finance index | 0.031 | 0.032 | 0.041 | 0.040 | 0.043 | 0.065 |
| | (0.61) | (0.60) | (0.51) | (0.52) | (0.49) | (0.30) |
| Fixed assets | | | | | | |
| | | | | | | |
| Financial cost | 0.299 | 1.265** | 0.092 | 0.403 | | |
| | (0.37) | (0.04) | (0.80) | (0.50) | | |
| Competition | | | 0.000 | 0.000 | 0.000 | 0.000* |
| | | | (0.49) | (0.33) | (0.74) | (0.08) |
| Innovation | 0.001 | 0.002 | | | 0.000 | 0.003 |
| | (0.69) | (0.24) | | | (0.84) | (0.17) |
| Financial cost * Innovation | | -0.207* | | | | |
| | | (0.06) | | | | |
| Financial cost * Competition | | | | -0.000 | | |
| | | | | (0.50) | | |
| Innovation* Competition | | | | | | -0.000* |

**Ethan Journal of Business Administration and Management**
ISSN: 2997-3147 |
Volume 10 Issue 3, July- September, 2022
Journal Homepage: https://ethanpub.online/Journals/index.php/E39
Official Journal of Ethan Publication

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | (0.08) |
| | | | | | | |
| Control | YES | YES | YES | YES | YES | YES |

### *6.2.* Equity Financing Constraints and Enterprise Innovation

By observing columns (1) and (3) of Table 10, digital inclusive finance can significantly stimulate enterprise innovation in both cases; However, in columns (2) and (4), the performance of enterprise innovation is not significant, and the results of Sobel test are not significant, which cannot pass the intermediate effect test. It is worth noting that when the explained variable is the overall financing constraint index KZ index, enterprise innovation passes the relevant test, and the results are inconsistent with this part. Therefore, it can be inferred that for equity financing cost, the measure of subdivided financing constraints, digital inclusive finance can directly affect equity financing constraints without relying on enterprise innovation.

Table 10: Testing the intermediary effect of enterprise innovation

| variable | (1) | (2) | (3) | | ( 4) | |
|---|---|---|---|---|---|---|
| | Traditional measurement m odel | | Spatial Du rbin model | | | |
| | Innovation | Equity financing cost | Equity financing | Wx | Innovation | Wx |
| Innovation | | 0.000 | | | | |
| | | (0.84) | | | | |
| Finance index | 0.819** | -0.000 | -0.003 | 0.065 | 9.605** | -3.508 |
| | (0.02) | (0.99) | (0.96) | (0.48) | (0.04) | (0.62) |
| Control | YES | YES | YES | | Y | ES |

## 7. Conclusions and Policy Recommendations

Based on the panel data of China's small and medium-sized enterprises listed on Shenzhen Stock Exchange from 2014 to 2020 and the Peking University Digital Inclusive Finance Index, this paper analyzes the impact of digital inclusive finance on the equity financing constraints of small and mediumsized enterprises from multiple dimensions, including benchmark regression, heterogeneity analysis and influence channel test. After the robustness test, the following conclusions are finally reached:

(1) Digital inclusive finance can effectively alleviate the equity financing constraints of micro, small and medium-sized enterprises. The empirical study finds that the total digital financial index, digital financial depth index and digital financial breadth index all have significant reducing effect on the equity financing constraints of micro, small and medium-sized enterprises.

(2) In terms of spatial spillover effect, digital inclusive finance has a significant easing effect on equity financing constraints of local smes, but deepens the financing constraints of related enterprises in surrounding provinces. The reason, or the bad competition caused by the siphon effect, makes the inclusion of digital finance difficult to play and present.

(3) From the perspective of transmission mechanism, under the traditional econometric model, the ratio of fixed assets and enterprise innovation are important channels for digital inclusive finance to alleviate the financing

constraints of smes, while enterprise innovation is not an important channel for digital inclusive finance to alleviate the equity financing constraints of smes.

(4) The existence of spatial factors will reduce the intermediation effect of digital financial inclusion on financing constraints. By incorporating spatial factors into the empirical model, the assumption of independence in the traditional econometric model is negated, and the closure and separation of each subject are broken. The empirical results of this paper show that compared with the traditional econometric model, the intermediary effect test based on the spatial Durbin model assumes that the threshold of intermediary variables is significantly increased, the intervention of spatial effects makes the intermediary effect significantly weakened, and the explanatory variables are more inclined to directly affect the explained variables.

The above conclusions reveal that digital inclusive finance plays a vital role in easing the equity financing constraints of smes, promoting the vigorous development of smes and achieving high-quality economic development, which has important policy implications and enlightenment. This paper puts forward the following policy recommendations:

(1) Build a digital economic ecology that supports the long-term development and progress of digital inclusive finance.

(2) The formulation of digital financial inclusion policies follows the principle of differentiation.

(3) Break down the barriers of the digital economy and attach importance to the benign development of digital inclusive finance and the benign interaction between small, medium and micro enterprises.

(4) For smes, unilateral enterprise innovation cannot effectively alleviate the equity financing constraints of smes, so it is necessary to strengthen the effect of the important transmission mechanism of enterprise innovation and fixed assets.

**References**

Wang Huan. Does the pilot policy of innovative industrial clusters promote the development level of urban high-tech industries? "Modern Economic Research. 04(2022):94-104.

Yu Zhen, Zhou Lei. How does digital Finance affect the cost of corporate equity financing? Mechanism test, heterogeneity characteristics and economic consequences [J]. Journal of Finance and Accounting, 2022(03): 57-60.

Huang Rui, Lai Xiaobing, Tang Song. How does Fintech affect corporate financing constraints? -- Dynamic effects, heterogeneity characteristics and macro and micro mechanism testing [J]. International Finance Research, 2020(6):9.

Wei Zhihua, Zeng Aimin, Li Bo. Financial ecological environment and Corporate Financing constraints: An Empirical Study of Listed companies in China [J]. Accounting Research, 2014(5):8.

Fang Hongxing, Shi Jikun. Verification of voluntary internal control and cost of equity capital: Empirical Evidence from Shanghai A-share non-financial Listed Companies [J]. Economic Management, 2011(12):7.

Yu Minggui, Zhong Huijie, Fan Rui. Privatization, financing constraints and Firm Innovation: Evidence from Chinese industrial firms [J]. Financial Research, 2019(4):17.

Yu Xuefang. The Relationship between Short Loan and long Investment and Financing constraints of Private Enterprises: Empirical evidence from listed companies in China [J]. Business and Management, 2015(05): 91-93.

Bang L, Jianhua Z, Economics S O. Does China's Inclusive Finance Innovation Ease the Financing Constraints of Small and Medium-Sized Enterprises [J]. Forum on Science and Technology in China, 2018. [9] Huan-Huan L I , School Z B .Study on the Mechanism of Sharing Finance to Alleviate the Financing Constraints of Small and Medium-Sized Enterprises[J]. Sci-tech Innovation and Productivity, 2020.

Li Yanling, Wang Mengxin, Liao Gaoke, Wang Junxia. Spatial Spillover Effect and Threshold Effect of

Digital Financial Inclusion on Farmers' Income Growth—Based on Provincial Data of China [J]. Sustainability, 2022, 14(3).

Milani S, Neumann R, Houser D, et al. R&D, patents, and financing constraints of the top global innovative firms[J]. Journal of Economic Behavior & Organization, 2022, 196:546-567.

Han H, Gu X. Linkage between inclusive digital finance and high-tech enterprise innovation performance: role of debt and equity financing [J]. Frontiers in Psychology, 2021, 12.

Li Y, Long H, Ouyang J. Digital Financial Inclusion, Spatial Spillover, and Household Consumption: Evidence from China [J]. Complexity, 2022, 2022.

Lu Z, Wu J, Li H, et al. Local bank, digital financial inclusion and SME financing constraints: Empirical evidence from China [J]. Emerging Markets Finance and Trade, 2022, 58(6):1712-1725.

Wang Z. Digital Finance, Financing Constraint and Enterprise Financial Risk [J]. Journal of Mathematics, 2022, 2022.

Yao L, Yang X. Can digital finance boost SME innovation by easing financing constraints? Evidence from Chinese GEM-listed companies[J]. Plos one, 2022, 17(3): e0264647.

Li J, Li B. Digital inclusive finance and urban innovation: Evidence from China [J]. Review of Development Economics, 2022, 26(2): 1010-1034.

Li Y K, Ren H Y, Zhu D F. Digital finance, share pledge and innovation investment of firms [J]. Science Research Management, 2021, 42(8): 102.

Yang Y, Liu S, Li Y. Research on the influence mechanism and regional heterogeneity of digital finance on enterprise innovation:—Empirical analysis based on private enterprises on GEM[C]//2021 International Conference on Computer, Blockchain and Financial Development (CBFD). IEEE, 2021: 514-518. [20] Ma F, Lei L, Chen Z, et al. Digital Finance and Firm Exit: Mathematical Model and Empirical Evidence from Industrial Firms [J]. Discrete Dynamics in Nature and Society, 2021, 2021.