

Article

# Digital Finance, Fiscal Transparency and Government Debt Risk

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**Abstract:** The expansion of the breadth of coverage and depth of use of digital finance greatly improves the efficiency of financial services to the real economy, and has an important impact on the economic development of local governments in China. This paper takes the provincial local government debt risk data from 2011 to 2020 as the research sample to deeply investigate the effect and mechanism of digital finance on local government debt risk. The results show that, firstly, digital finance can effectively suppress local government debt risk, and a significant long-term suppressive effect is found by quantile model test. Secondly, in the mechanism of action test, digital finance effectively alleviates local government debt risk through the path of local government fiscal transparency, and has played a significant regulating effect. Finally, based on different regions and development levels, the effect of digital finance on local government debt risk is found to be more significant in eastern regions and regions with high urbanization levels. The findings of this paper provide some theoretical value and practical significance for preventing the occurrence of local government debt risk and regional systemic risk.

**Keywords:** Digital Finance; Fiscal Transparency; Government Debt Risk; Mediating Effect; Moderating Effect

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## 1. Introduction

While local governments have played an important role in China's economic development by leaps and bounds over the past 40 years since the reform and opening-up, they have also caused a rapid expansion in the scale of local government debt, which has accumulated hidden risks for local governments. As of the end of December 2021, China's local government debt balance was as high as 3,047 billion yuan, which poses a huge challenge to local government fiscal revenues and expenditures, easily causing an imbalance between government fiscal revenues and expenditures and further intensifying the scale of local government debt and risk accumulation. Local governments are burdened with basic public service functions and economic development tasks, and the demand for funds for projects such as urban shantytown renovation, infrastructure construction and industrial structure upgrading forces, which make local governments to continue to expand the scale of debt. And debt risk gradually becomes an important resistance in the process of economic transformation. With the change of China's economy from high-speed growth to high-quality stage and the uncertainty of macroeconomic policy environment, the problem of local government debt risk has become increasingly prominent. The report of the 19th Party Congress even points out that

it is necessary to deepen the reform of the financial system and resolutely fight the hard battle to prevent and resolve major risks. Therefore, the prevention and resolution of local government debt risk has become an important topic of research for many scholars.

Local governments must have their own reasons for raising debt, mainly in the following three aspects: First, to achieve local economic development. In order to achieve urbanization, industrialization and the important responsibilities of local economic development, local governments raise funds through participation in PPP projects, government public service purchases, etc. In addition to increased fiscal spending and other reasons, local governments continue to expand external channels to raise funds, the scale of government debt continues to expand, thus triggering a sharp rise in the risk of local government debt [1, 2]. Second, it is influenced by the reform of fiscal decentralization system. There is a significant positive correlation between fiscal decentralization and local government debt risk. The reform of fiscal decentralization system has weakened the financial power functions of local governments, increased fiscal expenditures for transactional functions far beyond the government's own financial affordability, and the pressure of government budget constraints has further stimulated their need to achieve local development by raising debt [3, 4]. On the other hand, China's fiscal transfer payment system makes local governments believe that the central government will be willing to pay for their debts if they are unable to do so. At the same time, with the implicit guarantee of the central government, commercial banks and other financial institutions are willing to provide more financial support for local governments, increasing the enthusiasm of local governments in lending behavior [5]. Third, the influence of the political system. Due to the pressure of their own performance during their tenure, the stimulation of promotion mechanism and the competition of debt between governments, all stimulate the expansion of local government debt scale, laying hidden dangers for local government debt risks, which may eventually induce the occurrence of systemic financial risks [6–8].

With the development of Internet technology, digital finance, a product of the combination of finance and technology, has come into being. Digital finance has greatly subverted the traditional financial industry development model, relying on big data, blockchain and other technologies to open new paths for the realization of financial services to the real economy. On the one hand, it breaks the space limitation and reduces information asymmetry. Unlike traditional offline financial services, digital finance breaks spatial constraints and uses big data technologies such as the Internet to integrate customer information and promote direct transactions between the supply side and the demand side [9]. At the same time, with the support of Internet technology, relevant information collection and communication barriers are effectively enhanced to alleviate the information asymmetry problem of traditional financial service models and improve risk identification and control capabilities [10, 11]. On the other hand, the efficiency of financial services to the real economy is improved and the financial environment is improved. The policy and targeting characteristics of digital finance have an important guiding role in promoting the "de-funding" of finance, optimizing the financial service environment and innovating financial products, which greatly improves the mode of obtaining financing through banks and other financial institutions, eases financing constraints. It is of great significance to improve the efficiency of financial services for the real economy and achieve optimal allocation of capital [12, 13].

In summary, it is important for local governments to ensure the circulation of local financial resources and maintain the normal operation of the local economy by means of indebtedness.

However, excessive government indebtedness may lay hidden dangers for the stability and development of local market economy and financial market. At the same time, the development of digital finance has an important role in improving the financial environment, solving the problem of "difficult and expensive financing" for enterprises, improving the efficiency of capital allocation and reducing transaction costs. As an important subject in the financial market, can the local government debt crisis be improved under the development of digital finance? Therefore, this paper incorporates digital finance into the debt risk framework and tries to clarify the effects and mechanisms of digital finance on local government debt risk. This paper specifically expands on the following two aspects: First, it studies whether digital finance plays a significant role in local government debt risk from the perspective of digital finance, which has important academic value and practical significance for financial risk management and stabilization of financial markets. Second, we dig deeper into the potential mechanism of action between digital finance and local government debt risk, which provides important solution ideas for local governments to alleviate financial imbalance and prevent debt risk.

## 2. Theoretical Analysis and Research Hypothesis

The effective combination of Internet technology and finance drives the rapid development of digital finance in China. Due to the development and popularity of digital technologies such as cloud computing and mobile payment in China, the expansion of digital finance inclusiveness and practicality is promoted, which greatly boosts the development of digital finance. From the perspective of inclusiveness, digital finance combines technologies such as big data and artificial intelligence to establish a bridge between market players and investment players, and the low-cost access model can expand the breadth of digital finance coverage and help alleviate problems such as information transparency and asymmetry. From the practical point of view, the use of digital finance technology can accelerate the construction of the link between China's multi-level capital market, provide a more effective way for risk management, and achieve the goal of "de-focusing" financial services to the real economy. Therefore, this paper deeply analyzes the effect and mechanism between digital finance and local government debt risk, which is of great practical significance to strengthen the combination of digital and finance and prevent financial risks.

### 2.1. Digital Finance and Local Government Debt Risk

Digital finance makes full use of technologies such as big data, blockchain and cloud computing to break the traditional risk regulation model and play an important role in potential risk identification and warning, the characteristics of digital finance are gradually coming to the fore. On the one hand, digital finance improves information asymmetry, promotes the increase of financial revenue and reduces the occurrence of risks, and the multi-scene applications it creates help to spread the depth of use and coverage of information through various channels, greatly reducing the phenomenon of information opacity, making any transaction "nowhere to hide" and "traceable". Local governments do not need to rely on the traditional model for debt raising, and make full use of digital financial technology to scientifically design the price and maturity structure of local government bonds, promote local bond market reform, effectively reduce the risk of local government debt default, and stabilize the financial market order. At the same time, local governments can crack down on tax evasion and financial money laundering through digital

financial technology, which enhances the efficiency of local government fund allocation and the increase of local fiscal tax revenue, and reduces the probability of financing through external channels. In addition, local governments can solve the problems of "scale mismatch" and "maturity mismatch" through Internet technology, provide scientific and reasonable arrangements for local government debt financing, maximize the efficiency of capital utilization, and reduce the possibility of debt risks.

Overall, local government debt risk has a negative guiding effect on the generation and outbreak of regional systemic risks, jeopardizing the stability of financial markets and sustainable and healthy economic development, and how to prevent and resolve local government debt risk has become an important dilemma for governments at all levels. In response to the emerged problems, digital finance provides feasible ideas for solving local government debt risks and promotes financial stability to a certain extent. Based on the above research analysis, this paper proposes hypothesis one.

H1: Digital finance has a significant dampening effect on local government debt risk.

## *2.2. Influence Mechanism: Improving Financial Transparency*

The cost effect, coverage effect and usage effect of digital finance is not only an important means to promote the high-quality development of China's economy, but also an important path to address the development of financial services for the real economy. In addition to promoting inclusive economic growth, the development of digital finance also has an important impact utility on fiscal behavior [14] and a significant differential promotion effect on local tax revenue, which can significantly increase the positive stimulation effect of digital finance on local tax revenue through coverage breadth. Meanwhile, with the expansion of local government debt, understanding the financial situation of local governments has become an urgent task. In 2014, the State Council pointed out that it is necessary to build a standardized and transparent budget system, prevent and resolve fiscal risks, and regularly disclose clear information about government bonds and project investments to the society. It is thus clear that local financial transparency also affects debt risk, and digital finance has significant advantages in addressing the information asymmetry between the government and the public, greatly alleviating the need to improve the barrier between the government and the public and greatly increasing government financial transparency through integration of government debt situation, investment situation, and financial flows. Some scholars study local government management from the perspective of fiscal transparency and find that increased fiscal transparency significantly enhances information sensitivity, which has a debilitating effect on the size of local debt [15]. Others believe that digital finance affects the scale and cost effect of local government financing through two ways: fiscal transparency and financial resource allocation efficiency [11]. Based on this, this paper proposes hypothesis two.

H2: Digital finance can improve the financial transparency of local governments to curb the risk of local government debt.

## **3. Study Design**

### *3.1. Model Construction*

#### **3.1.1. Baseline Regression Model**

Based on the above theoretical analysis and research hypotheses, this paper constructs the baseline regression model:

$$\lgdrisk_{j,t} = \beta_0 + \beta_1 dif_{j,t} + \sum_{i=2}^5 \beta_i control + \varepsilon_{j,t} + \tau_{pro,year} \tag{1}$$

where  $\lgdrisk_{j,t}$  is the explanatory variable, which indicates the debt risk status of province or city  $j$  at time  $t$ . And  $dif_{j,t}$  is the core explanatory variable, indicating the digital financial level of province or city  $j$  at time  $t$ ; the control variables mainly include the level of economic development, industrial structure, urbanization level, fiscal deficit rate, urban unemployment rate, marketization index, and macroprudential regulation index.  $\varepsilon_{j,t}$  is the random error term;  $\tau_{pro,year}$  denotes controlling for individual spatial and time fixed effects.

### 3.1.2. Quantile Regression Model

To further investigate the differential impact of digital finance on local government debt risk, this paper constructs a panel quantile regression model for estimation tests in order to estimate the dynamic evolution characteristics of digital finance more accurately on government debt risk at different quantile points, with the following model settings:

$$Y_q[\lgdrisk_{j,t} | Q_{j,t}(dif)] = Q_{j,t}(dif)\theta_q \tag{2}$$

In equation (2), the  $Q_{j,t}(dif)$  denotes the core influencing factors and other influencing factors of local government debt risk.  $Y_q[\lgdrisk_{j,t} | Q_{j,t}(dif)]$  denotes the values of local government debt risk at different quantile points  $q$  when other influencing factors are established.  $\theta_q$  denotes the regression coefficients of the influenced explanatory variables at different quartiles  $q$ . Also, in order to accurately estimate the regression coefficients  $\theta_q$  that solves the minimization problem, the estimated model is shown in equation (3).

$$\min \sum_{\lgdrisk_{j,t} \geq Q_{j,t}(Dif)\theta_q} q |\lgdrisk_{j,t} - Q_{j,t}(dif)\theta_q| + \sum_{\lgdrisk_{j,t} < Q_{j,t}(Dif)\theta_q} (1-q) |\lgdrisk_{j,t} - Q_{j,t}(dif)\theta_q| \tag{3}$$

where  $n$  denotes the sample size and the meaning of the variable is consistent with the above. Also, the different quantile points selected are 10%, 25%, 50%, 75% and 90% of the five quantile points to verify the differential evolutionary characteristics of digital finance on local government debt risk.

## 3.2. Variable Selection and Measurement

### 3.2.1. Explained Variable: Local Government Debt Risk

The explanatory variable in this paper is local government debt risk. And referring to the studies of related scholars [16], the KMV model is used to measure the risk of local government debt in China. This paper uses local government revenue  $F_t$  replaces the value of enterprise assets, and local governments should repay their debts  $B_t$ , from which the default distance of local governments in China can be deduced.

Local government revenues  $F_t$  obeys a random distribution of  $F_t = f(X_t)$ , when the local government is unable to pay its debts, i.e.,  $F_t < B_t$ , then a default will result. At this point, the probability of default of the local government is:

$$p = p(F_t < B_t) = p[f(X_t) < B_t] = p[X_t < f^{-1}(B_t)] \tag{4}$$

When  $X_T \sim N(0,1)$ , equation (4) can become:

$$p = p[X_T < f^{-1}(B_T)] = N[f^{-1}(B_T)] \tag{5}$$

Assume that local government revenues  $F_t$  obeys the stochastic process:  $dF_t = gF_t dt + F_t dX_T$ ,  $t = 0, F_t = F$ , then the local government revenue is:

$$F_t = F \exp[(g - \frac{1}{2}\sigma^2)t + \sigma\sqrt{t}X_t] \tag{6}$$

$$E(\ln F_t) = \ln F + gt - \frac{1}{2}\sigma^2 t, \text{var}(\ln F) = \sigma^2 t \tag{7}$$

Based on the above assumptions, the growth rate  $g$  and volatility of local government revenues  $\sigma$  can be measured:

$$\sigma = \sqrt{\frac{1}{n-2} \sum_{t=1}^{n-1} (\ln \frac{F_{t+1}}{F_t} - \frac{1}{n-1} \sum_{t=1}^{n-1} \ln \frac{F_{t+1}}{F_t})^2} \tag{8}$$

$$g = \frac{1}{n-1} \sum_{t=1}^{n-1} \ln \frac{F_{t+1}}{F_t} + \frac{1}{2}\sigma^2 \tag{9}$$

According to equations (8) and (9), the local government default distance DD can be obtained.

$$DD = \frac{\ln \frac{F_t}{B_t} + (g - \frac{1}{2}\sigma^2)(T-t)}{\sigma\sqrt{T-t}} \tag{10}$$

In this paper, default distance is used as a proxy variable for local government debt risk, and the larger the value of default distance, the lower the probability of default risk for local governments. The default risk of local governments in China is measured according to equation (10).

### 3.2.2. Core Explanatory Variables: Digital Finance

This paper adopts the Digital Inclusive Finance Index compiled by the Digital Finance Research Center of Peking University as a proxy variable for digital finance. This index includes three first-level indices in addition to the total index, which are breadth of coverage, depth of use, and degree of digital support services. Therefore, this paper mainly selects the total digital finance index, the breadth of coverage and the depth of use for the empirical study of this paper.

### 3.2.3. Mediating Variable: Fiscal Transparency

The development of digital finance strongly improves the ability of information collection and processing, greatly enhances the transparency of local government finance, and has an important impact on the prevention and control of local government debt default. Therefore, it is important to study the mechanism of the role between digital finance and local government debt risk. In this paper, we select Tsinghua University's Research Report on Financial Transparency of Chinese Urban Governments to measure the financial transparency status of each provincial local government, and process it by weighting and other methods as the final proxy variable.

### 3.2.4. Control Variables

1) Level of economic development: The level of economic development of a region will have an important impact on the default status of government debt in that region, and this paper uses GDP per capita to measure the level of economic development of local governments. 2) Industrial structure: The main purpose of local governments to raise funds is to achieve long-term development of the local economy, and the shape of regional industrial structure also has a stronger impact on the scale of local government debt and the probability of default. Therefore, this paper measures the industrial structure status by the share of secondary industry in GDP. 3) Level of urbanization: The level of urbanization of local governments can expand the size of government debt, which may exacerbate the probability of government default. Therefore, this paper measures the level of urbanization of a place by the percentage of urban population. 4) Fiscal deficit ratio: The fiscal deficit ratio is an accurate reflection of the local government debt situation, and to a certain extent, measures the local governments fiscal revenue and expenditure gap. Therefore, this paper reflects the fiscal deficit rate of local governments by the measure of fiscal expenditure minus fiscal revenue divided by fiscal revenue. 5) Urban unemployment rate: The proportion of urban unemployment to the sum of urban employment and unemployment is selected to measure. 6) Marketization index: The index was selected according to the China Marketization Index Report based on the measurement of their environmental system. 7) Macro-prudential regulation: as local governments obtain funds through financing platforms and bond issuance to promote local economic development, the central government may take corresponding regulatory measures to prevent potential default risks. Therefore, this paper refers to relevant studies [17] and selects the macro-prudential supervision system of China published by the International Monetary Fund to measure the macro-prudential supervision index.

**Table 1.** Results of descriptive statistics for each variable.

Variable name	Variable definition	Observations	Average value	Standard deviation	Minimum value	Maximum value
lgdrisk	Local Government Debt Risk	310	3.295	3.998	-7.447	14.812
dif	Digital Finance	310	5.219	0.668	2.909	6.068
fsp	Financial Transparency	310	3.603	0.433	2.639	4.573
edl	Economic Development Level	310	9.784	0.884	7.223	11.619
est	Industry Structure	310	0.413	0.083	0.158	0.620
ubl	Level of Urbanization	310	0.588	0.124	0.350	0.938
czl	Fiscal Deficit Rate	310	1.536	1.699	-0.602	10.800
syl	Urban Unemployment Rate	310	3.255	0.637	1.210	4.610
sch	Marketability Index	310	7.941	1.892	3.359	11.934
regu	Macro-prudential Regulation	310	3.800	1.539	2.000	7.000

### 3.3. Data Sources and Descriptive Statistics

This paper focuses on the relationship between digital finance and local government debt risk, using sample data from 31 provinces and cities from 2011 to 2020, with data mainly from the China Statistical Yearbook and Wind database. The results of descriptive statistics of each variable in this paper are shown in Table 1.

## 4. Empirical Results and Analysis

### 4.1. Benchmark Test Results

#### 4.1.1. Baseline Regression Effect and Dynamic Effect

**Table 2.** Estimated results of baseline regression and dynamic effects of digital finance affecting local government debt risk.

Variables	lgdrisk: Government debt risk			
	Baseline return	Dynamic effects		
		Lagging 1 period	Lagging 2 periods	Lagging 3 periods
	(1)	(2)	(3)	(4)
dif	-1.036 *** (-3.14)			
L1.dif		-1.131*** (-3.58)		
L2.dif			-1.118 * (-2.95)	
L3.dif				-1.494*** (-4.33)
edl	-3.494*** (-3.41)	-2.199** (-1.99)	-2.048* (-1.89)	0.301 (0.22)
est	3.217*** (6.00)	2.145*** (5.06)	1.811*** (3.94)	1.097*** (2.95)
ubl	-0.469** (-2.01)	-2.138*** (-3.33)	-4.910*** (-4.70)	-0.575 (-1.07)
czl	0.382** (2.24)	0.357** (2.16)	0.336** (2.06)	0.932*** (4.30)
syl	0.870*** (4.13)	0.913*** (4.17)	0.885*** (3.86)	0.714*** (2.83)
sch	-0.346** (-2.10)	-0.212* (-1.66)	-0.179 (-1.60)	-0.163 (-1.55)
regu	-0.152* (-1.90)	-0.166** (-2.07)	-0.292*** (-3.09)	-0.101 (-1.01)
constant	8.702*** (7.89)	7.140*** (6.94)	3.069 (1.30)	-5.6748 (-1.05)
Time/area fixed effects	Y	Y	Y	Y
N	310	270	240	210
Adjusted R2	0.0581	0.0473	0.2792	0.3299

Note: t-values are in parentheses, and \*\*\*, \*\*, \* indicate significance levels at 1%, 5%, and 10%, respectively.

Table 2 mainly shows the results of the baseline regression and dynamic effect estimation for the impact of digital finance on local government debt risk. Column (1) of Table 2 shows the results of the benchmark regression, which shows that the estimated coefficient of digital finance is -1.036 and passes the 1% significance test. This result indicates that digital finance has a significant inhibitory



effect on local government debt risk, and hypothesis 1 is initially tested. On the one hand, digital finance breaks the traditional financing model of local governments, promotes the development of diversity of financing methods and channels, realizes real-time monitoring of local government fund flows through technical means, reduces the possibility of local governments hiding negative news, releases favorable information to the capital market and investment subjects, and helps reduce the possibility of local government debt risk. On the other hand, the application of financial technology can help local governments innovate financing tools and rationalize the scale and maturity structure of local bonds, mitigate the consequences caused by the imbalance of local government finance, and realize the optimal allocation of resources.

Is the negative shock effect of digital finance on local government debt risk a short-term choice or a long-term driver? This paper further investigates the variability of the long-term and short-term effects of digital finance on local government debt risk by referring to the dynamic effects test, and the estimated results are shown in columns (2) to (4) of Table 2. It is found that the estimated coefficients of digital finance pass the 1% significance test, which indicates that the inhibitory effect of digital finance is not a "fleeting" effect, but has a significant long-term effect, which also supports the correctness of hypothesis 1.

Regarding the estimation results of the control variables, the level of economic development and local government debt risk show a negative effect, and the improvement of economic development level contributes to the control of local government debt risks. While the change in industrial structure promotes the increase in local government debt risk, which is mainly due to the fact that the upgrading and transformation of economic structure imposes a huge burden on local finances and requires external funding to achieve this goal, causing the expansion of debt scale and further stimulating the accumulation of debt risk. There is a significant positive effect between urban unemployment rate and government debt risk, and the high unemployment rate increases the government's expenditure on livelihood protection, which increases the financial pressure on local governments. Meanwhile, the level of urbanization, the level of marketization and external macro regulation play a negative impact on debt risk, which fully indicates that the improvement of urbanization level, marketization level and macro prudential regulation are beneficial to the suppression of local government debt risk.

#### 4.1.2. Quantile Model Test

Table 3 mainly examines the impact effect of digital finance at different quartiles, and found that the inhibitory effect of digital finance did not find significant variation, and this inhibitory effect showed a trend of strengthening.

The explanation for this is that, on the one hand, the development of digital finance promotes the economic growth and marketization level of local governments, and the demand for funds is not too urgent, and it also reduces the financing cost and suppresses the government debt risk. On the other hand, the development of digital finance greatly enhances local government information disclosure, improves information liquidity and accuracy, reduces the cost of information access for the public, and alleviates information asymmetry, which ultimately affects local government debt risk. Therefore, hypothesis 1 is further verified.

**Table 3.** Results of the quantile test for the impact of digital finance on government debt risk.

Variables	lgdrisk: Government debt risk				
	(1) q=0.1	(2) q=0.25	(3) q=0.5	(4) q=0.75	(5) q=0.9
q					
dif	-2.501*** (-3.40)	-2.857** (-4.98)	-3.535*** (-7.79)	-4.517*** (-7.98)	-5.672*** (-8.46)
edl	-1.383** (-2.33)	-1.349** (-2.08)	-1.430** (-2.39)	0.547 (1.20)	0.584 (1.08)
est	2.460** (2.12)	2.015* (1.92)	1.356* (1.78)	-8.774** (-2.32)	-9.640** (-2.15)
ubl	-10.970*** (-2.66)	-12.235*** (-3.81)	-16.618*** (-6.54)	-11.622*** (-3.67)	-6.826* (-1.82)
czl	0.618*** (2.47)	0.164 (0.84)	0.242* (1.67)	0.131 (0.68)	0.307** (1.99)
syl	1.710*** (4.31)	1.619*** (5.24)	1.922*** (7.87)	1.779*** (5.84)	1.524*** (4.22)
sch	-2.137*** (-4.05)	-0.455 (-1.11)	-0.568* (-1.75)	-0.716* (-1.77)	-0.889* (-1.85)
regu	-0.218** (-1.86)	-0.392** (-1.98)	-0.368** (-2.36)	-0.357* (-1.83)	-0.445* (-1.93)
constant	4.337*** (3.79)	5.248*** (3.05)	6.133*** (5.60)	5.417*** (4.75)	5.217*** (5.35)
Time/area fixed effects	Yes	Yes	Yes	Yes	Yes
N	310	310	310	310	310
Adjusted R2	0.3892	0.3492	0.3375	0.3682	0.3908

Note: t-values are in parentheses, and "\*\*\*, \*\*, \*" indicate significance levels at 1%, 5%, and 10%, respectively.

#### 4.2. Robustness Test and Endogeneity Treatment

##### 4.2.1. Robustness Test

In this paper, we downscaled the total digital finance index and used digital finance coverage breadth and depth of use to replace the total digital finance index for robustness testing, and the specific estimation results are shown in columns (1) and (2) of Table 4. It can be found that the robustness test estimation results are basically consistent with the baseline regression estimation results, and digital finance still has a significant inhibitory effect on local government debt risk, which fully indicates that the research findings of this paper are robust and reliable.

##### 4.2.2. Endogenous Processing

In order to better deal with the possible endogeneity problem, this paper applies the systematic GMM method and instrumental variables method to further verify the robustness of the estimation results, which are shown in Table 4. In the systematic GMM test, the significance and direction of the effects of digital finance and local government debt risk do not change significantly. In the instrumental variable method test, this paper selects the number of Internet broadband access users as an instrumental variable, mainly because the number of Internet broadband access users reflects the degree of using Internet technology to obtain information and the popularity of Internet technology from the side, which has an important influence on the development of digital finance, but there is a weak connection or even unrelated, satisfying the condition of exogeneity of instrumental variables. It can be found that in column (4), the number of Internet broadband access users has a significant effect on digital finance, and the F-value in the first stage is 37.31, which is

greater than 10, and the instrumental variables in this paper are valid. In the second stage estimation results in column (5), the estimated coefficient of digital finance is consistent with the baseline regression estimation results, and there is no significant variation, and it passes the 5% significance verification. Therefore, the regression estimation results of this paper are robust.

Table 4. Robustness test and endogeneity treatment empirical results.

Variables	Robustness tests		Endogenous processing		
	Digital finance index downscaling		System GMM method	Instrumental variables method	
	(1) Breadth lgdrisk	(2) Depth lgdrisk	(3) lgdrisk	(4) First stage dif	(5) Second stage lgdrisk
lba				0.381*** (4.33)	
dif	-0.658** (-2.41)	-0.941*** (-2.84)	-2.003** (-2.41)		-1.407*** (-3.15)
edl	-3.952*** (-4.09)	-3.698*** (-3.79)	0.180 (0.49)	1.002*** (6.58)	-0.133 (0.37)
est	2.164*** (6.85)	2.036*** (6.26)	2.265*** (6.32)	-3.703*** (-6.76)	2.811** (5.07)
ubl	-0.934** (-2.16)	-0.448* (-1.88)	0.979 (1.25)	-0.072 (-0.07)	-0.929*** (-3.95)
czl	-0.355 (-1.15)	-0.325 (-1.07)	0.085 (0.82)	-0.159*** (-3.42)	0.067 (0.48)
syl	0.868*** (4.11)	0.876*** (4.16)	0.762** (2.02)	-0.124*** (-2.62)	0.834*** (2.46)
sch	-0.353** (-2.12)	-0.309** (-2.00)	-0.329*** (-2.95)	0.045 (1.39)	2.179*** (9.62)
regu	-0.120 (-1.59)	-0.104 (-1.50)	-0.220*** (-2.69)	-0.121*** (-12.45)	-0.941*** (-4.81)
constant	29.607*** (3.76)	29.815*** (3.85)	7.802 (1.09)	-4.615*** (-3.88)	33.084*** (6.71)
Time/area fixed effects	Yes	Yes	Yes	Yes	Yes
N	310	310	310	310	310
Adjusted R2	0.0303	0.0344	---	0.8940	0.6940
Phase 1 F-value				37.31	
Cragg-Donald Wald Values					39.33

Note: t-values are in parentheses, and "\*\*\*, \*\*, \*" indicate significance levels at 1%, 5%, and 10%, respectively. In the systematic GMM estimation, AR(1) is 0.015, AR(2) is 0.303, and Sargan and Hansen are 0.327 and 0.228, respectively. In the instrumental variables test, the F-value in the first stage is 37.31, and in the second stage the Kleibergen-Paap rk LM statistic and Hansen J statistic had p-values of 0.000 and 0.432, respectively.

### 4.3. Mechanism of Action Test

After verifying the direct transmission mechanism between digital finance and local government debt risk, it is necessary to consider through what channels digital finance may affect local government debt risk? According to the theoretical analysis and research hypothesis of this paper, this paper takes fiscal transparency as an important intermediate variable to test the effect of the mechanism of digital finance affecting local government debt risk, and the specific econometric model is shown in equations (11) and (12).

$$fsp_{j,t} = \alpha_0 + \alpha_1 dif_{j,t} + \sum \alpha_i control + \varepsilon_{j,t} + \psi_{pro,year} \tag{11}$$

$$lgdrisk_{j,t} = \omega_0 + \omega_1 dif_{j,t} + \omega_2 fsp_{j,t} + \sum_{i=3}^6 \omega_i control + \mu_{j,t} + \varphi_{pro,year} \tag{12}$$

Table 5 mainly describes the mechanism of the effect of digital finance on the risk of local government debt. In the test of mediating effect, the effect of influence between digital finance and fiscal transparency is mainly verified, and the results show that the regression coefficient of digital finance is 0.728, which passes the 1% significance verification. It indicates that digital finance has a significant positive influence on fiscal transparency, and digital finance helps to improve the fiscal transparency of local governments, which means that fiscal transparency is an important digital finance influence on local government debt risk mediating factor, and hypothesis 2 was initially verified.

**Table 5.** Estimation results of the test of the mechanism of action of digital finance affecting local government debt risk.

Variables	Intermediary effects		Moderating effects
	(1) fsp	(2) lgdrisk	(3) lgdrisk
dif	0.327*** (6.53)	-1.910* (-1.71)	-2.656*** (-1.88)
fsp		-0.287*** (-2.86)	-0.674*** (-3.11)
dif*vsp			0.553** (2.2)
edl	0.123** (2.02)	-1.025* (-1.87)	-4.063*** (-3.65)
est	-2.125*** (-4.16)	16.743*** (4.64)	26.069*** (5.74)
ubl	-0.326 (-0.78)	-6.323 (-1.54)	-0.222 (-0.04)
czl	0.031 (1.25)	-0.716*** (-3.44)	-0.333 (-1.03)
syl	0.230*** (2.72)	1.061*** (5.24)	0.878** (4.12)
sch	0.073 (1.61)	-0.637** (-2.15)	-0.320 (-1.02)
regu	-0.235** (-2.44)	-0.221*** (-2.74)	-0.157* (-1.96)
constant	1.162** (1.99)	2.720*** (3.39)	2.577*** (3.21)
Time/area fixed effects	Yes	Yes	Yes
N	310	310	310
AdjustedR <sup>2</sup>	0.0623	0.3206	0.0394

Note: t-values are in parentheses, and "\*\*\*, \*\*, \*" indicate significance levels at 1%, 5%, and 10%, respectively.

According to the mediating effect model action, if  $\omega_1$  insignificant and  $\omega_2$  is significant, it indicates that digital finance affects local government debt risk exclusively through the pathway of fiscal transparency; if  $\omega_1$  and  $\omega_2$  both pass the significance test, it implies that fiscal transparency plays only a partial mediating effect. Therefore, from column (2) of Table 5, it can be found that the regression coefficients of both digital finance and fiscal transparency pass the significance verification,

which also indicates that fiscal transparency plays an important partial mediating effect in the process of digital finance affecting local government debt risk, and hypothesis 2 is fully verified.

After considering the mediating effect, it is also important to consider whether fiscal transparency plays a moderating effect is also a key concern of the mechanism of action test. Therefore, the interaction term of digital finance and fiscal transparency is added to the benchmark model, and the specific test results are shown in column (3) of Table 5. It can be found that fiscal transparency has a significant moderating effect on digital finance to suppress local government debt risk, and fiscal transparency further releases the suppressive effect of digital finance on local government debt risk, and hypothesis 2 is further verified from the perspective of moderating effect.

#### 4.4. Heterogeneity Test

**Table 6.** Heterogeneity test results.

Variables	lgdrisk: Government debt risk			
	Regional heterogeneity		Developmental level heterogeneity	
	(1) Eastern	(2) Midwest	(3) High level of urbanization	(4) Low level of urbanization
dif	-1.778** (-2.38)	-0.730 (-0.53)	-2.032*** (-2.91)	-0.875 (-1.05)
edl	-3.559** (-2.31)	-2.663 (-1.01)	-0.601 (-0.74)	-7.111*** (-3.22)
est	4.585*** (3.48)	4.017*** (2.89)	4.447*** (2.78)	2.649 (1.29)
ubl	-1.220* (-1.93)	1.150 (0.17)	-1.690*** (-2.88)	-0.561 (-1.17)
czl	0.833** (2.32)	-0.427* (-1.82)	1.652*** (3.29)	0.115 (0.35)
syl	0.697** (2.15)	0.593* (2.16)	0.486 (1.48)	1.230*** (4.05)
sch	-1.561** (2.55)	0.447 (1.01)	-0.085 (-0.18)	-0.873 ** (-2.17)
regu	-0.228* (-1.88)	1.127 (1.15)	-0.269** (-2.29)	-0.161* (-1.64)
constant	2.200*** (3.35)	-4.898 (-0.21)	2.975*** (4.13)	2.649*** (3.51)
Time/area fixed effects	Yes	Yes	Yes	Yes
N	110	200	140	170
Adjusted R2	0.0028	0.5470	0.0209	0.2785

Note: t-values are in parentheses, and "\*\*\*, \*\*, \*" indicate significance levels at 1%, 5%, and 10%, respectively.

After the baseline regression and quantile regression tests, this paper divides the research sample according to regions and development levels to further investigate whether the effect of digital finance on local government debt risk varies according to regional differences and development levels, and the results are shown in Table 6. In the regional heterogeneity test, it can be found that the baseline regression coefficient of digital finance passes the 1% significance test in the eastern region and has a significant inhibitory effect on local government debt risk, while it is not significant in the central and western regions. The explanation for this conclusion: digital finance is a combination of technology and finance, which has high requirements for technology level and environment. For the eastern region, with many high-tech enterprises and technical talents and financial support, the development level of digital finance is significantly higher than that of the

central and western regions, which has a significant role in promoting the application and development of digital finance and has a more significant impact on local government debt risk. The impact on local government debt risk is more significant. For the central and western regions, there is an obvious gap between the level of economic development and the eastern region, and more consideration is given to improving the regional economic level, which is not conducive to the development of digital finance. Therefore, digital finance in the developed eastern region is more likely to inhibit the expansion of local government debt risk compared to the central and western regions.

In the test of development level heterogeneity, it can also be found that the estimated coefficients of digital finance at different urbanization levels are -1.371 and -0.141, respectively. However, the negative effect of digital finance on local government debt risk is more significant in regions with high urbanization levels. Compared with regions with low urbanization levels, regions with high urbanization levels consider more about achieving high-quality economic development and pay more attention to the application and development of high technology levels, which creates a favorable atmosphere for the development of digital finance.

## 5. Conclusions

Along with the development of modern information technology in China, digital finance breaks through the traditional financial industry confinement and has an important role in China's macro economy and micro subjects. As a product of finance and technology, digital finance provides more efficient and convenient services for local governments' capital circulation, and offers a variety of possibilities in terms of financing subjects and path choices. Of course, the development of digital finance also greatly creates a favorable atmosphere for economic structural transformation and the construction of a double-cycle economic development pattern. On the other hand, the development of digital finance also has an important impact on the improvement of local government governance, effectively grasping the initiative of risk occurrence, balancing the relationship between government debt risk and economic development, and providing an important guarantee for promoting high-quality sustainable and healthy economic development.

According to the relevant theoretical analysis, this paper conducts an in-depth study on digital finance and local government debt risk, and empirically examines the effect and mechanism of digital finance on local government debt risk using national provincial panel data from 2011 to 2020 as the research sample, and the research results show that: first, digital finance has a significant inhibitory effect on local government debt risk. As the risk of local government debt rises, the inhibitory effect of digital finance presents long-term characteristics. Second, the results of intermediary and moderating effects show that fiscal transparency is an effective way for digital finance to reduce the risk of local government debt. Fiscal transparency can further release the negative impact effect of digital finance on local government debt risk. Third, after distinguishing the geographical and urbanization levels, the inhibitory effect of digital finance on local government debt risk is more significant in eastern regions and regions with high urbanization levels.

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