*sustainability*

MDPI

*Article*

# Digital Finance and High-Quality Development of State-Owned Enterprises—A Financing Constraints Perspective

**Haijuan Xie, Jinyuan Wen and Xiaohui Wang ***

Business School, Guilin University of Electronic Technology, Guilin 541004, China
* Correspondence: wangxiaohui@guet.edu.cn

**Abstract:** The report of the 20th National Congress pointed out that high-quality development is the primary task of building a modern socialist country in an overall sense. Based on the background of high-quality economic development in the new era, this document studies the influence mechanism between digital finance and high-quality development of state-owned enterprises based on total factor productivity (TFP) by taking A-share state-owned listed companies on the Shanghai and Shenzhen stock exchanges from 2015 to 2020 as samples. The findings are as follows: Digital finance promotes the high-quality development of state-owned enterprises by alleviating financing constraints; grouping regression shows that digital finance has a stronger driving effect on the high-quality development of large state-owned enterprises and enterprises with a high technical level. The threshold regression model shows that digital finance has a single threshold effect on the high-quality development of state-owned enterprises. Further research shows that the higher the development level of supply chain finance, the stronger the influence of digital finance on the high-quality development of state-owned enterprises through financing constraints. The higher the shareholding ratio of institutional investors, the stronger the mediating effect of financing constraints. The research results of this paper not only enrich the research on the factors that influence the high-quality development of state-owned enterprises but also provide support for the government to formulate high-quality development policies for enterprises.

**Keywords:** digital finance; financing constraints; high-quality development of state-owned enterprises; supply chain finance; shareholding ratio of institutional investors



**Citation:** Xie, H.; Wen, J.; Wang, X. Digital Finance and High-Quality Development of State-Owned Enterprises—A Financing Constraints Perspective. *Sustainability* **2022**, *14*, 15333. https://doi.org/10.3390/su142215333

Academic Editors: David G. Fernandez and John Beirne

Received: 17 September 2022
Accepted: 14 November 2022
Published: 18 November 2022



## 1. The Introduction

The report of the 20th National Congress pointed out that high-quality development is the primary task of building a modern socialist country in an overall sense. We should stick to the theme of promoting high-quality development, integrate the strategy of expanding domestic demand with deepening supply-side structural reform, and enhance the internal driving force and reliability of the great domestic cycle. The 20th National Congress of the Communist Party of China (CPC), held on 16 October 2022, proposed that high-quality development is the primary task of comprehensively building a modern socialist country, which has elevated high-quality development to an unprecedented height. China's economy is undergoing a critical period of transformation and upgrading. State-owned enterprises are the "vanguard" of China's economy. The high-quality development of state-owned enterprises is the foundation of China's high-quality economic development and an important part of its long-term development. The Three-year Action Plan for SOE Reform (2020–2022) states that we will tap into the internal potential of SOES, stimulate their development momentum, and boost their high-quality development. Under the conditions of reform and open policy and through an accurate system as a whole, state-owned enterprises have tangible requirements for development in order to reach a high quality (hong-jun xiao, 2020) [1] but the "financing difficulty" restricts the development of state-owned enterprises to some extent, and state-owned enterprises encounter several

problems. Specifically, they include backward digital technology, the low efficiency of financing allocations, insufficient factor input, a lack of economies of scale, and a lack of innovation in organizational structures. In short, the low level of total factor productivity of state-owned enterprises is one of the reasons state-owned enterprises cannot develop to a high quality. The total factor productivity of enterprises is the output growth that can be explained by digital technology progress, financing allocation efficiency improvement, factor input, economies of scale systems, and organizational structure innovation, which can fully reflect the development level of enterprises in all aspects. Therefore, this paper adopts the total factor productivity to measure the high-quality development of state-owned enterprises.

The emergence of new digital technology provides a new way to solve the embarrassing predicament of state-owned enterprise development. In other words, digital finance based on big data and digital technology can efficiently collect information, reduce time, information, and transaction costs, reduce the default risk of both parties, and broaden financing channels with the help of the Internet trading platform. Theoretically, it can effectively solve the problem of "difficult financing" and "expensive financing" for enterprises and promote the development of state-owned enterprises. However, the increasing complexity of digital financial technology also intensifies the operational risks of state-owned enterprises (Li Xiaoling, 2020) [2], which limits the economic activities of state-owned enterprises. Therefore, scholars have not reached a consensus on the impact mechanism of digital finance on state-owned enterprises, and it is still necessary to carry out in-depth theoretical research and empirical tests on the impact mechanism.

At present, through the collection of literature, it is found that most of the research on the high-quality development of state-owned enterprises focuses on information disclosure, party building, and mixed ownership reform. Research on digital finance focuses on capital markets, urban and rural income, etc. It can be seen that although scholars have conducted in-depth research on the high-quality development of state-owned enterprises, there are the following shortcomings: First, the research is narrow. The path of realization of combining high-quality development of state-owned enterprises with digital finance is studied. Second, most research on the high-quality development of state-owned enterprises is theoretical research, with few empirical studies. Therefore, in view of the above problems, this paper constructs the research framework for the high-quality development of state-owned enterprises and digital finance and adds a financing constraint as an intermediary variable to explore the influence mechanism of digital finance on the high-quality development of state-owned enterprises. It not only enriches the related research on the digital finance of state-owned enterprises at the micro level but also expands the theoretical research on the influencing mechanism of the high-quality development of state-owned enterprises at the macro level so as to provide a basis for the formulation of high-quality development policies of state-owned enterprises.

## 2. Related Literature and Research Hypotheses

### *2.1. Digital Finance and High-Quality Development of State-Owned Enterprises*

Fundamentally speaking, state-owned enterprise is the basic unit of the social economy. The high quality of economic development is the cornerstone of state-owned enterprises, and state-owned enterprises' high-quality development differs from high-speed growth as a new kind of economic development mode, which reflects quality first and efficiency second (Jin Bei, 2018) [3]. It also enhances the total factor productivity, adhering to the "quality first" strategy. The new development of "benefit first" enables state-owned enterprises to realize or exist in a new paradigm state of a high level, with a high level of excellent enterprise development quality (Huang Sujian, 2018) [4]. In this context, digital finance plays an important role.

By exerting basic functions such as supervision and control, resource allocation, and risk control, the financial system promotes the improvement of capital and technology level of state-owned enterprises and becomes an important driving force for the high-quality

development of micro subjects (Wang Daoping, Liu Linlin, 2021) [5]. Different from mature foreign financial systems, domestic traditional financial markets have low vitality and a lack of efficiency. On the one hand, the fund bond market is turbulent, and on the other hand, the CSRC sets a high entry and exit threshold for stock issuance, which results in state-owned enterprises' access to financing being blocked, and banks become the main channel for state-owned enterprises' financing needs. Under the constraints of this system, the domestic capital market leads to the problems of resource misallocation and high risk in the operation of the traditional system due to the opaque and asymmetric information of both sides, which restricts the high-quality development of state-owned enterprises. With the rise of emerging technologies such as big data and blockchain, digital finance has emerged to break through the bottlenecks of the traditional system, reduce credit costs, expand the scope of online and offline services, and inject strong impetus into the high-quality development of state-owned enterprises. From the perspective of development logic, digital finance relies on the generation of 5G and Internet technology. Through online digital technology, it can improve the information transparency of both parties, reduce the cost of information transactions, enhance fair and mutual trust transactions, and provide more opportunities for the development of state-owned enterprises 3. In terms of the development environment of state-owned enterprises, state-owned enterprises face complicated information in the development process of internal and external environments. Digital finance can mine the information text deeply and assist financial institutions to obtain the true and accurate operation situation of state-owned enterprises, so as to make the right decision. At the same time, it is also convenient for state-owned enterprises to self-certify their credit, improve their information transparency, and promote cooperation between state-owned enterprises and financial institutions (Xie, X.; Shen, Y., 2018; Tang, S.; Lai, X.B, 2019) [6,7]. For investors' willingness, digital finance breaks through the extensive services of traditional finance and transforms it into a precise, customized, and personalized intelligent push, which is conducive to improving investors' investment willingness, attracting high-quality investors, reducing the possibility of irrational decisions impacting the capital market, and promoting the high-quality development of the capital market. The benign operation of the capital market can not only improve the governance environment of SOES but also improve their production and operation capacity and greatly improve their financing environment, which provides the core driving force for their innovative investment and high-quality development. In view of this, this paper proposes the following hypothesis:

**Hypothesis 1.** *The development of digital finance can promote the high-quality development of state-owned enterprises.*

### *2.2. Digital Finance, Financing Constraint, and Intermediary Transmission Mechanism of High-Quality Development of State-Owned Enterprises*

Financing constraints represent a key indicator reflecting the development quality of state-owned enterprises, which is of great significance in driving the transformation of state-owned enterprises from high-speed growth to high-quality development. Digital finance can break through the limitations of the traditional financial system, provide credit support to more state-owned enterprises, and ease financing constraints so as to solve the problem of "difficult financing" and "expensive financing" for the high-quality development of state-owned enterprises.

From the perspective of "financing difficulties", traditional financing is limited by geographical and spatial factors, and the loans granted by banks are "discriminatory", while some state-owned enterprises and other tail groups are "discriminated" against due to the lack of collateral and opaque financial information and are unable to enjoy financing services. In recent years, with the rise of emerging technologies, digital finance has broken through the traditional limit, and therefore we must change the traditional financial system, build the "financial supermarket" or "supply chain finance", reduce the threshold of financial services extending from the end of the supply chain to the supply of capital, improve the matching degree of supply, and demand both sides of the capital accord. These

strategies will help the tail group to gain access to financial services and, in turn, enhance the possibility of financing the supply of state-owned enterprises (Li Qinyang, 2021) [8] and effectively solve the problem of "financing difficulty" of state-owned enterprises.

From the perspective of "expensive financing", it can be traced to the asymmetry of information. First, the development of digital finance can reduce the cost of information acquisition for state-owned enterprises. Digital finance can effectively reduce the cost of information by improving the financial structure, improving the quality of information disclosure, and enhancing the transparency of market information. Second, financing rates can be lowered. Digital finance uses big data text mining technology to collect multidimensional data including customer credit data, transform unstructured information into structured information, conduct in-depth analysis and research, establish a trustworthy third-party credit investigation system, reduce the default risk of both parties, and reduce the financing interest rate (Zhang Xiaoyan, 2021; Ye Yong, Wang Sirui, 2021) [9,10] Third, it can reduce the time requirements. Digital finance can rely on the digital credit investigation platform to simplify the credit examination procedures and processes of financial institutions, overcome regional restrictions, reduce the time required for information transmission, greatly improve the efficiency of information transmission, and make the financing of state-owned enterprises faster and more efficient.

Therefore, digital finance can significantly improve the financing environment of state-owned enterprises by alleviating the problems of "difficult financing" and "expensive financing" of state-owned enterprises, thus injecting core power into the high-quality development of state-owned enterprises and promoting high-quality development. In view of this, this paper proposes the following hypothesis.

**Hypothesis 2.** *Financing constraints have a mediating effect between digital finance and the high-quality development of state-owned enterprises*.

## 3. Study Design

### *3.1. Sample Selection*

The study selected A-share state-owned listed companies in Shanghai and Shenzhen from 2015 to 2020 as samples, excluding samples of financial, ST, and ST* state-owned enterprises in the sample of state-owned enterprises, and finally obtained a total of 5127 observations, among which 507 were small and medium-sized enterprises and 4620 were large enterprises. There were 2614 high-tech enterprises and 2513 non-high-tech enterprises. The sample data were collected from CSMAR and Wind databases and analyzed by Stata and SPSS. All variables were winsorized for 1% and 99% indentation.

### *3.2. Variable Design*

#### 3.2.1. Explained Variables

High-Quality Development of State-owned Enterprises (TFP): The total factor productivity of enterprises is the output growth that can be explained by digital technology progress, financing allocation efficiency improvement, factor input, the scale economy system, and organizational structure innovation, which can fully reflect the development level of enterprises in all aspects. Therefore, this article refers to the practice of Lu Xiaodong and Lian Yujun (2012) [11] and uses the total factor productivity as a measurement index to measure the high-quality development of state-owned enterprises. To avoid the influence of collinearity, heteroscedasticity, and individual extrema on the sample data and ensure the sample data approach the normal distribution, the LP method was used for measurement.

#### 3.2.2. Explanatory Variables

Digital Finance (DIF): This paper adopts the financial Inclusion index compiled by the Digital Finance Research Center of Peking University (Guo Feng, 2020) [12] to quantitatively analyze the development of different regions. The index is compiled based on massive financial data, and the development level of digital finance is positively correlated with

the value of the index. Based on the practice of Zhang Xiaoyan, 2021 [9] the macro variable digital finance is matched with the office address of micro state-owned enterprises. Meanwhile, to solve the problem of excessive digital finance values, the index is divided by 100.

#### 3.2.3. Mediating Variables

Financing constraint (SA): This is measured by the SA index constructed by Hadlock and Piers (Hadlock, Pierce, 2010) [13] Because the SA index has exogeneity and is determined by the size and age of the companies, it can accurately measure the financing constraints of state-owned companies. The calculation formula of the SA index is $SA = -0.737 \times Size + 0.043 \times size_2 - 0.04 \times Age$. Age represents the age of the enterprise and size represents the scale of the enterprise. The calculation results of the SA index are less than 0. For the convenience of analysis, the absolute value of SA is taken. The smaller the value, the weaker the financing constraint of state-owned enterprises.

#### 3.2.4. Control Variables

The following variables are selected as control variables: The asset–liability ratio (Lev), fixed assets ratio (PPE), return on investment (ROA), enterprise trial period (Age), enterprise size (Size), and cash flow (Cash). In addition, this paper also controls for time-fixed effects (Year) and industry-fixed effects (Industry).

The specific definition and value of the methods, symbols, and control variables of each variable are shown in Table 1.

**Table 1.** Variable definition table.

| | Variable Name | Variable Sign | Variable Explanation |
|---|---|---|---|
| Explained variables | High-quality development of state-owned enterprises | TFP | Total Factor Productivity of Enterprises (LP method) |
| Explanatory variables | Digital financial | DIF | Match digital Finance index/100 by office address of listed company |
| Mediating variables | Financing constraints | SA | $-0.737 \times Size + 0.043 \times Size_2 - 0.04 \times Age$The absolute value |
| Control variables | Asset liability ratio | Lev | Total liabilities/total assets |
| | Proportion of fixed assets | PPE | Fixed assets/total assets |
| | Return on assets | ROA | Net profit/total assets |
| | Years of listing | Age | Take the logarithm of the age of the firm plus 1 |
| | The enterprise scale | Size | Total assets at the end of the year are taken as the natural logarithm |
| | Cash flow | Cash | Cash flow from operating activities/operating income |
| | year | Year | Year dummy variable |
| | industry | Ind | Industry dummy variable |

### *3.3. Model*

Referring to the step-by-step test method adopted by Wen Zhonglin (2004) [14], the mediation effect test is divided into four steps for testing, and the corresponding model is constructed as follows:

$$TFP_{i,t} = \alpha_1 + a_1 DIF_{i,t} + \sum \gamma control_{i,t} + \sum year + \varepsilon_{i,t} \quad (1)$$

$$SA_{i,t} = \alpha_2 + b_2 DIF_{i,t} + \sum \gamma control_{i,t} + \sum year + \varepsilon_{i,t} \quad (2)$$

$$TFP_{i,t} = \alpha_3 + c_1 SA_{i,t} + \sum \gamma control_{i,t} + \sum year + \varepsilon_{i,t} \quad (3)$$

$$TFP_{i,t} = \alpha_4 + d_1 DIF_{i,t} + d_2 SA_{i,t} + \sum \gamma control_{i,t} + \sum year + \varepsilon_{i,t} \quad (4)$$

Model (1) is used to test the relationship between digital finance and the high quality of state-owned enterprises. If the coefficient $a_1$ is significantly positive, it means that digital finance is positively correlated with the high-quality development of state-owned enterprises.

Model (2) is used to test the relationship between digital finance and financing constraints. If the coefficient $b_2$ is significantly negative, it means that digital finance is negatively correlated with financing constraints.

Model (3) is used to test the relationship between financing constraints and the high-quality development of state-owned enterprises. If the coefficient $c_1$ is significantly negative, it means that financing constraints are negatively correlated with the high-quality development of state-owned enterprises.

Model (4) is used to test Hypothesis 2. If the coefficient $d_1 < \beta_1$ and the significance of the coefficient is significantly reduced, it means that financing constraints have a mediating effect between the impact of digital finance on the high-quality development of state-owned enterprises.

Among them, TFP represents the high-quality development level of state-owned enterprises; DIF stands for digital financial intensity; SA represents the level of financing constraints; $\alpha$ is a constant coefficient; $\beta$, $\gamma$, and $\delta$ represent the regression coefficients of the variables to be measured; Control refers to the control variable studied in this paper; $\sum$ year denotes the year-fixed effect; $\varepsilon$_(I, t) represents the random error of model estimation; I denotes different enterprises (885 in total); and T denotes different times (2015–2020).

## 4. Empirical Analysis and Test

### *4.1. Descriptive Statistics*

Table 2 lists the descriptive statistics of each variable. As an index to measure the high-quality development of state-owned enterprises, the average value of total factor productivity (TFP) is 9.668, the range between the minimum value of 5.348 and the maximum value of 13.717 is 8.369, and the variance is 1.476, indicating that the distribution of the total factor productivity of enterprises is relatively discrete. There are big differences in the level of development. The reason for the difference may be that the national policy favors different regions and industries or that the scale and type of state-owned enterprises are different. The minimum value of the digital finance variable (DIF) is 1.963, the maximum value is 3.345, and the standard deviation is 0.273, indicating that the development of digital finance in the sample country is generally low and the development difference is large. The maximum and minimum values of the financing constraint variable (SA) are 5.311 and 2.829, respectively, indicating that there are great individual differences in the financing constraint activities of the sample state-owned enterprises, and the average value is 3.948, indicating that almost all state-owned enterprises have different degrees of financing constraint problems. The median financing constraint was 3.954 and the average was 3.948, indicating that the overall level of financing constraints of state-owned enterprises was similar.

**Table 2.** Descriptive statistical analysis.

| | Sample Size | The Minimum Value | The Maximum | The Median | The Average | The Standard Deviation | The Variance |
|---|---|---|---|---|---|---|---|
| TFP | 5127 | 5.348 | 13.717 | 9.553 | 9.668 | 1.215 | 1.476 |
| DIF | 5127 | 1.963 | 3.345 | 2.808 | 2.768 | 0.273 | 0.075 |
| SA | 5127 | 2.829 | 5.311 | 3.954 | 3.948 | 0.268 | 0.072 |
| Lev | 5127 | 0.027 | 1.698 | 0.480 | 0.476 | 0.199 | 0.039 |
| PPE | 5127 | 0.000 | 0.834 | 0.199 | 0.242 | 0.181 | 0.033 |
| ROA | 5127 | −0.760 | 0.366 | 0.029 | 0.028 | 0.066 | 0.004 |
| Age | 5127 | 0.693 | 3.434 | 2.890 | 2.655 | 0.631 | 0.398 |
| Size | 5127 | 19.652 | 28.636 | 22.883 | 22.985 | 1.433 | 2.054 |
| Cash | 5127 | −2.161 | 2.259 | 0.086 | 0.107 | 0.192 | 0.037 |

### *4.2. Cluster Analysis of High-Quality Development of State-Owned Enterprises*

In order to deeply study the status quo of the high-quality development of state-owned enterprises, this paper conducts a K-means clustering analysis on the high-quality development of state-owned enterprises with the help of SPSS software, and the results are shown in Table 3. After 23 iterations, convergence is achieved, showing that the change of the cluster center is small and almost zero. The maximum absolute coordinate change of any center is 0.000 and the minimum distance between the initial centers is 2.494. According to the results presented in the table, the final clustering result can be obtained:

**Table 3.** Cluster analysis of TFP K means.

| TFP Clustering | First Clustering | Second Clustering | Third Clustering | Fourth Clustering |
|---|---|---|---|---|
| The initial clustering | 5.6260 | 8.1213 | 10.6151 | 13.1197 |
| The final clustering | 7.9156 | 9.0487 | 10.1513 | 11.5742 |
| Number of | 936 | 1903 | 1546 | 742 |

At present, the high-quality development of our country's state-owned enterprises is similar to a normal distribution curve ("the middle big two ends is small") and state-owned enterprise is concentrated in a second-level cluster and a third-level cluster (9.048 and; 10.1513). The number of cases was 1903 and 1546, accounting for 37.12% and 30.15% of the sample size, that is, nearly 70% of Chinese enterprises were in the middle stage of high-quality development, which was consistent with the descriptive statistics that showed the average value of TFP of Chinese enterprises' high-quality development variable was 9.668 and the median value was 9.553. However, there are a small number of state-owned enterprises in the first-level cluster. The initial cluster value is 5.6260, and the final cluster value is 7.9156, accounting for 18.26%. The proportion of low-end enterprises is not high, indicating that the high-quality development trend of state-owned enterprises in China is good. The state-owned enterprises in the fourth cluster, with an initial cluster value of 13.1197 and the final cluster value of 11.5742, are at a higher stage of high-quality development, accounting for 14.47%, which is the lowest proportion among the four clusters, indicating that even though some state-owned enterprises in China have achieved high-quality development, most of them do not have a high degree of high-quality development. Therefore, this study has theoretical value and practical significance.

### *4.3. Analysis of Correlation*

The results of the Pearson correlation analysis for each variable in this paper are shown in Table 4. It can be concluded from Table 4 that digital finance has a positive correlation with the high-quality development of state-owned enterprises, while digital finance has a negative correlation with financing constraints. Among them, digital finance has a significant positive relationship with the high-quality development of state-owned enterprises ($r = 0.132$, $p < 0.01$). There was a significant negative relationship between digital finance and financing constraints ($r = -0.033$, $p < 0.05$) and a significant negative relationship between financing constraints and the high-quality development of state-owned enterprises ($r = -0.229$, $p < 0.01$). In addition, except for the control variable, the correlation coefficient between the enterprise development scale and the high-quality development of state-owned enterprises is 0.815, and the correlation between other explanatory variables is less than 0.7. According to the above analysis, there is no serious multicollinearity problem among the variables.

**Table 4.** Correlation analysis of main variables.

| | TFP | DIF | SA | Lev | PPE | ROA | Age | Size | Cash |
|---|---|---|---|---|---|---|---|---|---|
| TFP | 1 | | | | | | | | |
| DIF | 0.132 *** | 1 | | | | | | | |
| SA | −0.229 *** | −0.033 ** | 1 | | | | | | |
| Lev | 0.427 *** | 0.021 | −0.106 *** | 1 | | | | | |
| PPE | −0.108 *** | −0.223 *** | −0.103 *** | −0.006 | 1 | | | | |
| ROA | 0.152 *** | −0.044 * | −0.02 | −0.333 *** | −0.035 * | 1 | | | |
| Age | 0.182 *** | 0.107 | 0.305 *** | 0.138 *** | 0.084 *** | −0.040 * | 1 | | |
| Size | 0.815 *** | 0.107 *** | −0.303 *** | 0.435 *** | 0.131 *** | 0.099 *** | 0.168 ** | 1 | |
| Cash | −0.050 | −0.039 * | −0.097 *** | −0.114 *** | 0.249 *** | 0.233 *** | 0.103 *** | 0.103 * | 1 |

Note: ***, **, and * represent significant at the statistical level of 1%, 5%, and 10%, respectively (two-tailed test).

### *4.4. Regression Analysis*

The mediating effect of financing constraints is successively tested, as shown in Table 5, which is as follows:

**Table 5.** Mediating effect test of financing constraint.

| Variable | Model (1) TFP | Model (2) SA | Model (3) TFP | Model (4) TFP |
|---|---|---|---|---|
| DIF | 0.0731 *** | −0.1306 *** | | 0.0558 *** |
| | (3.01) | (−15.47) | | (2.32) |
| SA | | | −0.1522 * | −0.1331 *** |
| | | | (−4.00) | (−3.42) |
| Lev | 0.8331 *** | 0.1565 *** | 0.7983 *** | 0.8123 *** |
| | (12.61) | (8.02) | (14.67) | (14.84) |
| PPE | −1.2719 *** | −0.048 *** | −1.2894 *** | −1.2655 *** |
| | (−20.17) | (−2.68) | (−26.38) | (−25.34) |
| ROA | 2.6265 *** | 0.4728 *** | 2.5430 *** | 2.5636 *** |
| | (10.73) | (8.06) | (15.47) | (15.58) |
| Age | 0.0951 *** | 0.199 *** | 0.0649 *** | 0.0686 *** |
| | (6.79) | (38.19) | (3.96) | (4.17) |
| Size | 0.6378 *** | −0.1282 *** | 0.6603 *** | 0.6548 *** |
| | (72.88) | (−48.25) | (76.56) | (73.30) |
| Cash | −0.1346 | 0.0225 ** | −0.1367 *** | −0.1376 *** |
| | (−1.02) | (2.49) | (−5.42) | (−5.45) |
| Adj-$R^2$ | 0.722 | 0.4222 | 0.7224 | 0.7227 |
| F | 1685.07 | 534.30 | 1902.89 | 1667.11 |

Note: ***, **, and * represent significant correlations at 0.01, 0.05, and 0.10 levels, respectively. The t value is in parentheses and the estimation result of the constant term is omitted.

Model (1) tests the total effect of digital finance on the high-quality development of state-owned enterprises. The regression coefficient of digital finance is 0.0731, which is significant at the 1% level, indicating that the high-quality development level of state-owned enterprises increases by 0.0731 units for every 1 unit of increase in digital finance, and digital finance positively affects the high-quality development level of state-owned enterprises. The direct effect of digital finance on financing constraints and the direct effect of financing constraints on the high-quality development of state-owned enterprises are successively tested.

Model (2) shows that the regression coefficient of digital finance on financing constraints is −0.1306, which is significant at the 1% level; that is, the development of digital finance is conducive to alleviating the financing constraint of state-owned enterprises. According to model (3), the regression coefficient of financing constraints on the high-quality development of state-owned enterprises is −0.1522, which is significant at the 10% level; that is, financing constraints will significantly inhibit the high-quality development of state-owned enterprises.

In model (4), the regression coefficient of digital finance on the high-quality development of state-owned enterprises is 0.0558, which is still significant at the 1% level. The coefficient of $\beta_3$ is significantly positive and $\delta_2$ is significantly negative, which means that digital finance can promote the high-quality development of state-owned enterprises by alleviating financing constraints. Meanwhile, compared with 0.0731 in model (1), the coefficient of $\beta_3 < \beta_1$ is significantly weaker, indicating that financing constraints play a part in mediating the effect between digital finance and the high-quality development of state-owned enterprises.

### *4.5. Test for Endogeneity*

The above research shows that the development of digital finance can promote the high-quality development of state-owned enterprises and produce a dynamic superposition effect in a certain time series, which plays a role in promoting the long-term development of state-owned enterprises. Some researchers, such as Xu Qingrui (2000) [15] believe that there is a "lag process" between the emergence and application of new technologies; that is, the effect of digital finance on the high-quality development of state-owned enterprises may be lagged. Therefore, in order to accurately investigate the effect of digital finance, not only the current period but also the lagged digital finance should be selected as the explanatory variable. At the same time, the lag effect of digital finance may also have an impact on financing constraints. Therefore, it is necessary to construct a regression model of financing constraints and the lag period of digital finance to investigate the change in the lag period of digital finance on financing constraints.

As can be seen in Table 6, the digital finance coefficient in (5) is 0.0731, with a significance level of 1%. The coefficient of lagged one-stage digital finance is 0.0594 and the significance level reaches 5%. In (6), the effect of a delay period of digital finance on financing constraints is significantly negative ($\beta_2 = -0.1155$, t = −11.53); that is, at the 1% level, the inhibition effect of a delay period of digital finance on financing constraints is also significant, indicating that the development of digital finance has a significant negative impact on the financing constraints of state-owned enterprises. Compared to (11) and (13), it can be seen that the high-quality development coefficient of digital finance in (7) is ($\beta_3 = 0.0468$, t = 1.64) and the high-quality development coefficient of digital finance in (5) is ($\beta_1 = 0.0594$, t = 2.11). The significance of the coefficient is obviously weakened when $\beta_3 < \beta_1$. Furthermore, $\beta_2$ in (6) is significant, $\delta_2$ in (7) is significant, and $\beta_3$ is significant, which means that even if digital finance lags in one stage, financing constraints still play a role in mediating the effect between digital finance and the high-quality development of state-owned enterprises. Therefore, based on research on the potential endogeneity problem, digital finance still significantly promotes the high-quality development of state-owned enterprises, which is consistent with the conclusion of the benchmark study.

**Table 6.** Endogeneity test.

| **Dependent Variable: High Quality Development of Enterprises** | **(5)** | **(6)** | **(7)** |
|---|---|---|---|
| | **TFP** | **SA** | **TFP** |
| DIF | 0.0731 *** (3.01) | −0.1306 *** (−15.47) | 0.0558 *** (2.32) |
| DITt-1 | 0.0594 ** (2.11) | −0.1155 *** (−11.53) | 0.0468 * (1.64) |
| SA | | | −0.1094 *** (−2.50) |
| Control variables | Control | Control | Control |
| Time effect and industry effect | Control | Control | Control |
| Adjust $R^2$ | 0.7226 | 0.4383 | 0.7230 |
| F | 1530.14 | 458.34 | 1341.36 |
| N | 4120 | 4120 | 4120 |

Note: ***, **, and * represent significant correlations at 0.01, 0.05, and 0.10 levels, respectively.

### *4.6. Test for Heterogeneity*

#### 4.6.1. Size Heterogeneity Analysis of State-Owned Enterprises

According to the division method of the State-owned Assets Supervision and Administration Commission of the State Council, this paper divides large enterprises into one group (column 1) and small and medium-sized enterprises into another group (column 2) according to a certain number of employees, turnover, and assets. This is to test whether there is a significant difference in the impact of digital finance on the high-quality development of state-owned enterprises of different sizes. The results are shown in Table 7. Group regression results show that digital finance plays a greater role in promoting the high-quality development of large state-owned enterprises. By comparing the estimated coefficients of the two groups of samples, the regression coefficients of large state-owned enterprises are larger than those of small and medium state-owned enterprises. This is because the process of digital finance marketization in large state-owned enterprises is faster than that in small and medium-sized state-owned enterprises, and the mechanism and system are more perfect, as are the infrastructure, network popularization, and supervision process. Therefore, large state-owned enterprises receive more opportunities from digital finance and are more strongly driven by digital finance.

**Table 7.** Heterogeneity analysis.

| **Dependent Variable: High Quality Development of Enterprises** | **(1)** | **(2)** | **(3)** | **(4)** |
|---|---|---|---|---|
| | **Large Enterprise Groups** | **Small and Medium Enterprises Section** | **High Technical Level Group** | **Non-High Technology Level Group** |
| Digital financial | 0.0841 *** (3.55) | 0.0547 (0.60) | 0.0752 *** (2.69) | 0.0671 ** (1.71) |
| Control variables | control | control | control | control |
| Time effect and industry effect | control | control | control | control |
| $R^2$ | 0.7179 | 0.3122 | 0.7640 | 0.6950 |
| Constant term | −5.1704 *** (−31.82) | −2.8317 *** (−3.14) | −5.589 *** (−17.45) | −7.3895 *** (−15.87) |
| N | 4620 | 507 | 2614 | 2513 |

Note: ***, ** represent significant correlations at 0.01, 0.05 levels, respectively.

#### 4.6.2. Heterogeneity Analysis of the Technological Level of State-Owned Enterprises

Under the new economic model, one of the important ways to promote high-quality economic development is to stimulate connotative innovation-driven growth (Zhang Junguan et al., 2019; Wang Daoping, Liu Linlin, 2021) [16,17] On this basis, this paper is grouped by the level of "technology level" to test whether there are significant differences in the impact of digital finance on the high-quality development of state-owned enterprises with different technology levels. Specifically, according to the practice of Liu Yunguo and Liu Wen (2007) and Wen, Z.; Zhang, L [17,18], state-owned enterprises are divided into high-tech state-owned enterprises and non-high-tech state-owned enterprises according to the level of technology, and a heterogeneity test is conducted on them. Table 7 presents the regression results, which show that digital finance has a greater incentive effect on state-owned enterprises with a high level of technology. Comparing the regression coefficients of the two groups of samples, the regression coefficients of the high-tech state-owned enterprise sample are larger than those of the non-high-tech state-owned enterprise sample. This may be due to the greater uncertainty of technology research and development and the longer investment recovery period. Furthermore, due to the need for operation and management, the information asymmetry of state-owned high-tech enterprises is more prominent, making their traditional financing more restricted. However, digital finance uses information technology to process a large number of unstandardized data to better

match the risk characteristics of high-tech companies, which can alleviate information asymmetry to a certain extent. Based on the above heterogeneity analysis, the development of digital finance can effectively improve the financing constraints existing in the traditional financial system, promote the high-quality development of state-owned enterprises, and realize the "dynamic change" of economic development.

### *4.7. Threshold Effect Analysis*

The results show that a great deal of financial high-quality development of state-owned enterprises has a remarkable positive influence, and because the digital financial impact on the high-quality development of state-owned enterprises is multi-dimensional, its influence on the digital financial strength and the financial aspects of the development level presents different characteristics, and there may be a nonlinear relationship between variables. Therefore, the panel threshold regression model proposed by Hansen (1999) [19] is used to test whether there is a nonlinear relationship between digital finance and the high-quality development of state-owned enterprises.

According to the threshold regression model, the *p*-value and F-value are calculated by 300 Bootstrap sampling methods to test whether digital finance has a threshold effect on the high-quality development of state-owned enterprises, and there are indeed several threshold effects. As can be seen from Table 8, DIF has a single threshold with an F value of 72.83 and a *p*-value of 0, which passes the test at the significance level of 1%. However, the F values of the double-threshold and triple-threshold tests are 15.89 and 7.88, and the *p* values are 0.2260 and 0.6740, respectively, which fail the significance test. It can be seen that digital finance has a single-threshold effect on the high-quality development of state-owned enterprises. As can be seen from Table 9, its single threshold value is 3.0147, which indicates that when the value of digital finance reaches 3.0147, the impact of digital finance on the high-quality development of state-owned enterprises will change. At different intervals, the impact of digital entry on the high-quality development of state-owned enterprises will be different.

**Table 8.** Test results of threshold effect.

| Threshold Variable | The Threshold Type | *p*-Value | F-Value | BS Number | Critical Value Level | | |
|---|---|---|---|---|---|---|---|
| | | | | | 10% | 5% | 1% |
| DIF | Single threshold | 0.000 | 72.83 *** | 500 | 19.7507 | 23.2699 | 34.4667 |
| | Double threshold | 0.2260 | 15.89 | 500 | 20.5808 | 25.2349 | 41.5413 |
| | Triple threshold | 0.6740 | 7.88 | 500 | 17.9044 | 21.3568 | 28.5783 |

Note: *** represent significant correlations at 0.01 levels.

**Table 9.** Threshold estimates and confidence intervals.

| Threshold Variable | Model | Estimate of Threshold | 95% Confidence Interval |
|---|---|---|---|
| DIF | The threshold value of 1 | 3.0147 | [3.0123, 3.0163] |

After the threshold value was determined, STAT software was used to draw an LR statistical map to observe whether the curves connected by the threshold values intersected at the horizontal interval of 95% confidence. If the curve crossed the horizontal dashed line (Figure 1), it was confirmed that the threshold value existed.

In addition to the threshold value, the panel threshold regression results of digital finance and the high-quality development of state-owned enterprises are obtained. According to the single threshold regression results in Table 10, when digital finance is lower than a single threshold value of 3.0147, the coefficient between digital finance and the high-quality development of state-owned enterprises is 0.1082. When digital finance develops further and is higher than a single threshold value, the coefficient of digital finance is 0.0701.

Although both of them pass the significance test at the level of 1%, it can be clearly seen that the coefficient of digital finance after crossing the threshold drops sharply compared with the coefficient before the threshold. This indicates that when the development degree of digital finance is approximately 3.0147, digital finance has the best promoting effect on the high-quality development of state-owned enterprises. In addition, by observing the regression results, the coefficients of digital finance are all positive, which can further confirm that digital finance positively affects the high-quality development of state-owned enterprises and verify the previous hypothesis again.

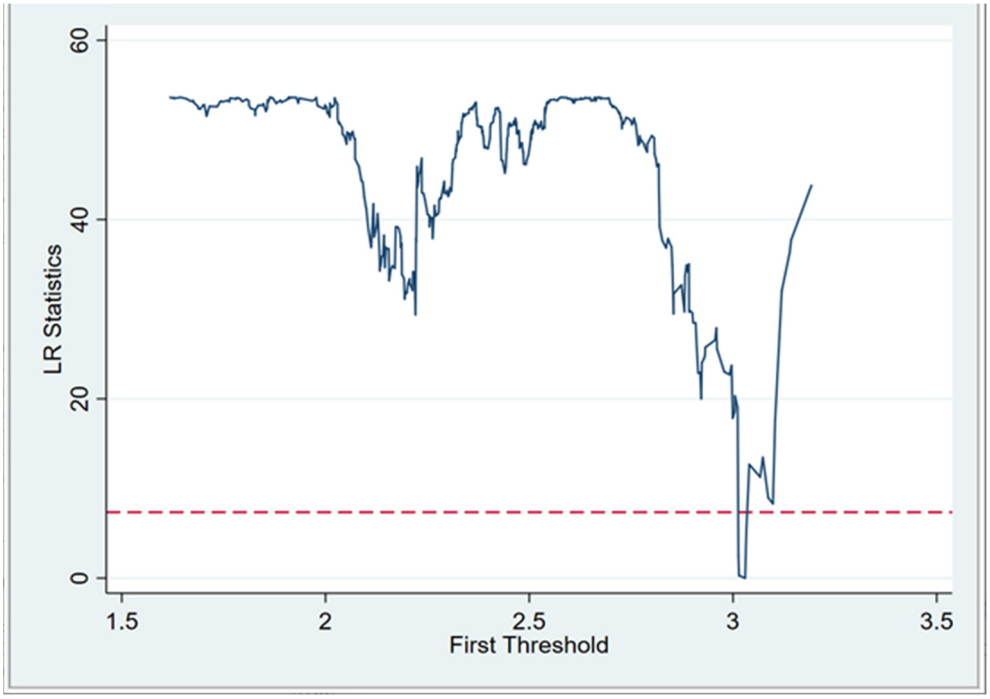


**Figure 1.** Single threshold confidence intervals for digital finance.

**Table 10.** Panel threshold regression results.

| Variable | TFP |
|---|---|
| DIF-lev1 | 0.1082 *** |
| | (4.46) |
| DIF-lev2 | 0.0701 *** |
| | (2.98) |
| Lev | 0.2356 *** |
| | (3.60) |
| PPE | −0.4657 *** |
| | (−6.48) |
| ROA | 1.5080 *** |
| | (14.33) |
| Age | 0.0656 |
| | (1.38) |
| Size | 0.6355 *** |
| | (36.61) |
| Cash | −0.0904 *** |
| | (−3.17) |
| Adj-$R^2$ | 0.6950 |
| F | 453.11 |

Note: *** represent significant correlations at 0.01 levels.

## 5. Further Analysis

### *5.1. Theoretical Analysis and Research Hypothesis of Regulatory Effect*

Although it has been proven above that digital finance can promote the high-quality development of state-owned enterprises through financing constraints, the simple analysis of the three mechanisms is not enough. This paper argues that because the external economic environment and internal corporate governance change with science and technology, laws and regulations, institutional policies, and so on, the driving effect of digital finance on the high-quality development of state-owned enterprises will also produce differentiation. The main manifestations are that state-owned enterprises actively seek new external financing modes, improve the financing environment, enhance information disclosure methods and quality, and better alleviate financing constraints. That is, some factors in the external environment of enterprises may regulate the relationship between "digital finance and financing constraints". At the same time, from the perspective of enterprises themselves, enterprises must constantly adjust their organizational structure to adapt to the external financial environment and the changing digital environment. By establishing a perfect internal mechanism, the company management level can be improved, the trust in financial institutions can be enhanced, and the value of the company can be realized. State-owned enterprises' internal environmental factors also may affect "financing constraints—state-owned enterprise high quality development" on the one hand and the relationship between them on the other hand (Zhang Xiaoyan, Li Jinbao, 2021) [9].

From the perspective of the external environment, in recent years, in order to better consolidate the "ballast" role of the real economy, the government formulated a series of policies during the 13th Five-Year Plan period, pointing out that the financial innovation of state-owned enterprises, especially the innovation of supply chain finance, should be paid attention to under the premise of the dominant position of commercial banks. With the development of digital finance, SOES can sign strategic partnerships with core SOES in the supply chain and apply for loans from banks with digital finance as the framework and core SOES as the guarantee. The application of the new financing model can not only expand the business scope of commercial banks and other financial institutions but also revitalize the capital of state-owned enterprises, enhance their competitiveness, and promote their high-quality development.

From the perspective of the internal environment, under the continuous development and improvement of the Chinese socialist market economy, institutional investors have become a pillar of China's security market and a major financing channel for listed companies in China. The introduction of institutional investors can not only inject more capital into the company but also enhance the investment and financial management ability of the company and effectively reduce the risk of irrational investment decisions due to lack of experience. At the same time, it can also effectively restrict the operation and management functions of senior management and prevent management from manipulating the earnings and profits of the enterprise through information asymmetry and thus reducing the value of the enterprise (Ye Yong, Wang Sirui, 2021) [10]. With the increase in the number of shares held by institutional investors, the financing mode of state-owned enterprises has changed greatly. Due to their high levels of professional ability and governance, institutional investors can effectively reduce the agency problem and information asymmetry so as to alleviate the financing constraints. The theoretical analysis shows that the supply chain changes under the action of financial and institutional investor shareholding, digital finance, and financing constraints, as does its relationship with state-owned enterprise high-quality development, but there is little literature research on the transmission mechanism, so this paper asserts that research on supply chain finance and institutional investors is of great significance.

#### 5.1.1. The Pre-Regulation of Supply Chain Finance

At the initial stage of the development of supply chain finance, foreign scholars have proposed solutions to the financing problems of state-owned enterprises, namely solving the financing problems of enterprises through supply chain management (Berger et al.,

2004) [20]. The traditional supply chain financing mode is established between the core company and a third-party logistics company, which is affected by the credit of the core company, the stability of the supply chain, the logistics situation, and even the macro policy, so it is difficult to effectively solve the financing constraint problem of the enterprise (Fu Weiqiong, 2020) [21]. As the liaison between the bank and the enterprise, the third-party logistics company supervises the movable property provided by the enterprise through the logistics service and provides effective business information for it. At the same time, based on the mastery and control of warehouse receipt information, it can make up for part of the information that the bank lacks, reduce information asymmetry to a certain extent, and alleviate financing constraints. Along with the development of digital finance, there are further cost advantages provided by the supply chain mode of financial innovation, the enterprise platform, the generalization of the service object, the diversification of the financial supply, the facilitation of information services, and more precise and faster data processing capabilities (Jiang Huifeng, Liu Yiping, 2021) [22]. These factors are better able to ease the "financing difficulties" and "financing expensive" problems. In summary, this paper presents the following hypothesis:

**Hypothesis 3.** *Financing constraints play a mediating role between the interaction term of supply chain finance and digital finance and the high-quality development of state-owned enterprises. That is, the higher the development level of supply chain finance, the stronger the impact of digital finance on the high-quality development of state-owned enterprises through financing constraints.*

5.1.2. The Post-Adjustment Effect of Institutional Investor Shareholding Ratio

The institutional investor shareholding mechanism is an important corporate governance mechanism in China. Compared with individual investors, institutional investors have more professional staff and investment experience, so they can provide more professional advice. This specialization can also be reflected in the optimization of the company's internal supervision and organizational structure, thereby reducing some operational risks and promoting the development of state-owned enterprises (Gallian et al., 2003) [23]. The increase in institutional investors' holdings can improve the transparency of financial information disclosure of state-owned enterprises, reduce the internal and external asymmetry to a certain extent, and reduce the default risk of both parties. Due to the credit and regulatory constraints, state-owned enterprises have to bear the burden of financing higher interest rates in the "financing your" problem. Scholars have found in previous studies that when institutional investors possess stakes of more than one node, their ability to ease financing constraints will be weakened with the increase in institutional investors' holdings, which presents a "threshold effect" and weakens the role of institutional investors' holdings in easing financing constraints (zhen red line, Wang Jinle, 2016) [24].

In summary, we assert the following hypothesis:

**Hypothesis 3.** *The shareholding ratio of institutional investors has a positive moderating effect on the mediating effect of financing constraints between digital finance and the high-quality development of state-owned enterprises; that is, the higher the shareholding ratio of institutional investors, the stronger the mediating effect of financing constraints and the higher the shareholding ratio of institutional investors, the stronger the impact of digital finance on the high-quality development of state-owned enterprises through financing constraints.*

Based on the above assumptions, the theoretical analysis framework constructed in this paper is shown in Figure 2.

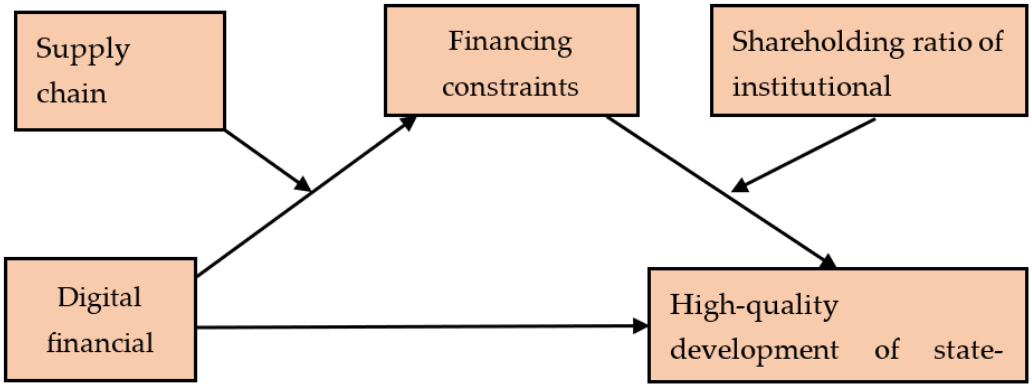


**Figure 2.** Theoretical analysis framework of this paper.

### *5.2. Empirical Research Design*

#### 5.2.1. Model Building

By referring to the test method in the mediation regulation model of Wen Zhonglin (2013) 20, the mediating effect of financing constraints on the interaction term between digital financial policies and supply chain finance on the high-quality development of state-owned enterprises was explored. We also tested whether the mediating effect of institutional investors' shareholding ratio on corporate financing constraints between digital financial policies and the high-quality development of state-owned enterprises has a moderating effect. The test model is constructed as follows:

$$TFP_{i,t} = \alpha_1 + a_1 DIF_{i,t} + a_2 \mathrm{SCF}_{i,t} + a_3 DIF_{i,t} \times \mathrm{SCF}_{i,t} + \sum \gamma control_{i,t} + \sum year + \varepsilon_{i,t} \quad (5)$$

$$SA_{i,t} = \alpha_2 + b_1 DIF_{i,t} + b_2 \mathrm{SCF}_{i,t} + b_3 DIF_{i,t} \times \mathrm{SCF}_{i,t} + \sum \gamma control_{i,t} + \sum year + \varepsilon_{i,t} \quad (6)$$

$$TFP_{i,t} = \alpha_3 + c_1 DIF_{i,t} + c_2 \mathrm{SCF}_{i,t} + c_3 DIF_{i,t} \times \mathrm{SCF}_{i,t} + c_4 SA_{i,t} + \sum \gamma control_{i,t} + \sum year + \varepsilon_{i,t} \quad (7)$$

$$TFP_{i,t} = \alpha_1 + d_1 DIF_{i,t} + d_2 II_{i,t} + \sum \gamma control_{i,t} + \sum year + \varepsilon_{i,t} \quad (8)$$

$$SA_{i,t} = \alpha_1 + e_1 DIF_{i,t} + e_2 II_{i,t} + \sum \gamma control_{i,t} + \sum year + \varepsilon_{i,t} \quad (9)$$

$$TFP_{i,t} = \alpha_1 + f_1 DIF_{i,t} + f_2 SA_{i,t} + f_3 II_{i,t} + f_4 II_{i,t} \times \mathrm{SA}_{i,t} + \sum \gamma control_{i,t} + \sum year + \varepsilon_{i,t} \quad (10)$$

The interaction coefficients $a_3$, $b_3$, $c_3$ of digital finance and supply chain finance and the coefficient $c_4$ of the mediating effect of the variable SA are successively analyzed. If the interaction coefficients $a_3$, $b_3$,$c_3$ are all significant and the coefficient $c_3 < a_3$, the financing constraints carried out by enterprises play a mediating role between the interaction terms of the digital finance policy and the supply chain finance and the high-quality development of state-owned enterprises. In turn, we determine the values of $d_1$,$e_1$,$f_3$. If $e_1 \neq 0$ and $f_3 \neq 0$, the shareholding ratio of institutional investors can moderate the mediating effect of the financing constraint between digital finance and the high-quality development of state-owned enterprises.

#### 5.2.2. The Pre-Regulation of Supply Chain Finance in the Intermediary Model of Financing Constraints

According to the mediation model test method, this paper is divided into three steps to test the pre-regulation role of supply chain finance in the financing constraint mediation model. The test results are shown in Table 11 The details are as follows: According to the test of model (5), the interaction term between digital finance and supply chain finance is significantly positively correlated with the high-quality development of state-owned enterprises ($a_3$ = 0.0768, t = 0.44). According to the test of model (6), the interaction term between digital finance and supply chain finance is significantly negatively correlated

with financing constraints ($b_3 = -0.169$, t = −2.68). In model (7), regarding the financing constraint ($c_4 = -1.0174$, t = −2.05), the interaction term between digital finance and supply chain finance ($c_3 = 0.1059$, t = 2.62) has a significant negative correlation with the high-quality development of state-owned enterprises, and the value and significance of the interaction term coefficient $c_3$ is smaller than that of the interaction term coefficient $a_3$ in model (5). It shows that financing constraints play a mediating role between the interaction term of supply chain finance and digital finance and the high-quality development of state-owned enterprises. Hypothesis 3 is verified. The above results show that the better the development of supply chain finance, the stronger the indirect effect of digital finance on the high-quality development of state-owned enterprises through enterprise financing constraints. That is, with the continuous development of digital finance, supply chain finance can effectively alleviate the financing constraints of state-owned enterprises by expanding the supply of digital financial services.

**Table 11.** Pre-regulation test of supply chain finance.

| Variable | Model (8) TFP | Model (9) SA | Model (10) TFP |
|---|---|---|---|
| DIF | 0.0904 *** | 0.1558 *** | 0.0740 *** |
| | (2.76) | (13.04) | (2.1) |
| SA | | | −1.0174 ** |
| | | | (−2.05) |
| SCF | 1.074 ** | 0.5377 *** | 0.0946 |
| | (2.46) | (3.38) | (0.48) |
| DIF × SCF | 0.1768 | −0.169 *** | 0.1059 *** |
| | (3.44) | (−2.68) | (2.62) |
| Lev | 0.3434 *** | 0.1088 *** | 0.3319 *** |
| | (5.41) | (4.69) | (4.65) |
| PPE | −1.3004 *** | −0.0512 *** | −1.2949 *** |
| | (−26.51) | (−2.86) | (−21.5) |
| ROA | 2.8189 *** | 0.4968 *** | 2.7663 *** |
| | (17.48) | (8.45) | (11.06) |
| Age | 0.0837 *** | 0.1981 *** | 0.0628 *** |
| | (5.86) | (38.03) | (3.96) |
| Size | 0.6518 *** | −0.1269 *** | 0.6653 *** |
| | (88.81) | (−47.42) | (66.72) |
| Cash | −0.1152 *** | 0.0243 *** | −0.1178 *** |
| | (−4.65) | (2.69) | (−0.99) |
| Adj-$R^2$ | 0.7327 | 0.4245 | 0.7331 |
| F | 1558.33 | 419.46 | 1275.02 |

Note: ***, ** represent significant correlations at 0.01, 0.05 levels, respectively.

#### 5.2.3. The Role of Shareholding Ratio of Institutional Investors in Post-Adjustment of Financing Constraint Mediation Model

According to the moderated mediation model testing method, this process was divided into three steps to test the post-adjustment effect of institutional investors' shareholding ratio in the financing constraint mediation model, and the results are shown in Table 12 The details are as follows: According to model (11), digital finance is significantly positively correlated with the high-quality development of state-owned enterprises ($d_1 = 0.0734$, t = 3.11); model (12) shows that digital finance is significantly negatively correlated with financing constraints ($e_1 = -0.1338$, t = −15.94). According to model (13), when the financing constraint is taken as the mediating variable, $e_1 \neq 0$ and $f_3 \neq 0$, indicating that the shareholding ratio of institutional investors has a moderating effect on the mediating effect of financing constraints between digital finance and the high-quality development of state-owned enterprises. Therefore, hypothesis 3 is verified. The above results show that the higher the shareholding ratio of institutional investors, the stronger the mediating effect on easing financing constraints and the more obvious the impact of digital finance on

the high-quality development of state-owned companies. That is, institutional investors under the corporate governance mechanism can promote the high-quality development of state-owned companies by providing more professional opinions and improving corporate information disclosure.

**Table 12.** Post-adjustment test of shareholding ratio of institutional investors.

| Variable | Model (11) TFP | Model (12) SA | Model (13) TFP |
|---|---|---|---|
| DIF | 0.0734 *** | −0.1338 *** | 0.0655 *** |
| | (3.11) | (−15.94) | (2.72) |
| SA | | | −0.4643 *** |
| | | | (−5.13) |
| II | −0.0136 | −0.158 *** | −3.8322 *** |
| | (−0.26) | (−8.58) | (−7.27) |
| SA × II | | | 0.9881 *** |
| | | | (7.32) |
| Lev | 0.8313 *** | 0.1354 *** | 0.7646 *** |
| | (15.15) | (6.93) | (13.85) |
| PPE | −1.2712 *** | −0.0392 *** | −1.2657 *** |
| | (−25.40) | (−2.20) | (−25.43) |
| ROA | 2.6302 *** | 0.5157 *** | 2.4839 *** |
| | (16.01) | (8.82) | (15.06) |
| Age | 0.0954 *** | 0.202 *** | 0.0841 *** |
| | (6.55) | (38.95) | (5.06) |
| SizeCash | 0.6387 *** | −0.1178 *** | 0.6699 *** |
| | (78.22) | (−40.53) | (70.04) |
| | −0.1343 *** | 0.0259 *** | −0.1408 *** |
| | (−5.31) | (2.88) | (−5.60) |
| Adj-$R^2$ | 0.7220 | 0.4303 | 0.7256 |
| F | 1661.89 | 483.35 | 1352.51 |

Note: *** represent significant correlations at 0.01 levels.

## 6. Research Conclusions and Suggestions

### *6.1. The Research Conclusions*

This paper selected data from 2015 to 2020 to study the impact of digital finance on the high-quality development of state-owned enterprises at the end of the 12th Five-Year Plan period and the start of the 13th Five-Year Plan period, which has certain practical significance. This paper used TFP as a measure of high-quality development and explored the influence mechanism of digital finance on the high-quality development of state-owned enterprises from the perspective of financing constraints, and the following conclusions can be drawn: First, digital finance can promote the high-quality development of state-owned enterprises by reducing the level of financing constraints. Second, the driving effect of digital finance on large state-owned enterprises and high-level technology enterprises is stronger than that of small and medium-sized enterprises and non-high-level technology enterprises. Thirdly, through the establishment of the threshold regression model, it was found that the impact of digital finance on the high-quality development of state-owned enterprises has a single threshold effect, and when digital finance is near 3.0147, digital finance has the best positive effect on the high-quality development of state-owned enterprises. Fourth, further research finds that the higher the development level of supply chain finance, the stronger the impact of digital finance on the high-quality development of state-owned enterprises through financing constraints. Furthermore, the higher the shareholding ratio of institutional investors, the stronger the mediating effect of financing constraints. The research of this paper enriches the related research on the relationship between digital finance, financing constraints, and high-quality development of state-owned enterprises, and provides data support and reasonable explanations for the government to formulate high-quality development policies for enterprises.

### *6.2. Countermeasures and Suggestions*

By improving the quality and level of international circulation, we will accelerate the creation of a modern economic system, increase the total factor productivity, enhance the resilience and safety of industrial and supply chains, promote urban–rural integration and coordinated development between regions, and promote the effective improvement in quality and rational growth in quantity. Under these conditions, state-owned enterprises follow the trend of the times to develop unique high-quality development of state-owned enterprises. In an environment of financial repression, financing constraints are not surprising, and the high-quality development of state-owned enterprises is increasingly constrained. Today, society has recognized the importance of the high-quality development of state-owned enterprises, but there is still a certain gap between the level of high-quality development of state-owned enterprises and the three-year Action Plan for State-owned Enterprise Reform. Therefore, this paper makes the following suggestions. First, the government should strengthen the relevant supporting policies and regulatory means through the overall strategic perspective. Furthermore, it should continue to improve the development of digital technology, strengthen the design and overall amount of financial planning, further expand the development of digital financial breadth and depth of use, address the problems that state-owned enterprises face regarding financing difficulty in the process of production and operation, and better serve state-owned enterprise high-quality development, with particular attention paid to small and medium-sized state-owned enterprises and high-tech enterprises. At the same time, the government should strengthen the use of science and technology supervision means in state-owned enterprises. Second, state-owned enterprises should take the initiative in digital transformation and adaptive evolution. We encourage full participation in digital financial development regarding the promotion of the development of state-owned enterprises. At the same time, state-owned enterprises should establish a mutually beneficial and win–win business model, which will improve the supply chain financial and institutional investors' holding value, improve the ability to build supply chain finance, increase institutional investors' participation in corporate governance, and increase the overall coordination effect between state-owned enterprises. Third, banks and other financial institutions should proactively introduce cutting-edge fintech to support the lending process. Bank-represented financial institutions are important channels for state-owned companies to obtain loan financing. Therefore, encouraging financial institutions to introduce cutting-edge fintech to improve loan efficiency and loan issuing technology is crucial to solving the problem of "difficult financing" and "expensive financing". Therefore, financial institutions should actively learn from fintech companies, introduce cutting-edge scientific and technological talents, and improve hardware and software facilities to help improve lending efficiency and loan issuing technology. Fourth, regulatory models should be innovated to prevent financial risks. Due to the COVID-19 pandemic in 2019, the risks of digital financial services have increased to a certain extent. To properly address the relationship between risk and innovation, a new regulatory model must be developed. Only by strengthening financial regulation can we properly handle the relationship between innovation and risk and more effectively address the role of financial innovation in supporting the real economy. Therefore, financial regulation will be the focus of subsequent work. On the one hand, financial activities should be fully regulated in accordance with the law, all kinds of financial chaos should be dealt with, and unreasonable and excessive innovation should be restrained through financial regulation. On the other hand, in the process of combining technology and finance, we should strengthen the protection of personal information and effectively safeguard the rights and interests of financial consumers.

**Author Contributions:** Conceptualization, H.X. and J.W.; methodology, J.W.; software, J.W.; validation, H.X., J.W. and X.W.; formal analysis, J.W.; investigation, J.W.; resources, J.W.; data curation, J.W.; writing—original draft preparation, J.W.; writing—review and editing, J.W.; visualization, J.W.; supervision, X.W.; project administration, X.W.; funding acquisition, H.X. and X.W. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was funded by [Western Program of Chinese Social Science Foundation and Guangxi Philosophy and Social Science Planning Project and Guangxi Philosophy and Social Science Planning Project] grant number [22XGL008 and 20FGLO27 and 22FDJ008] and The APC was funded by [22XGL008 and 20FGLO27].

**Data Availability Statement:** To use the data in this study, please email 20052201046@mails.guet.edu.cn.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. Xiao, H. High Quality development of State-owned Enterprises facing the 14th Five-Year Plan. *Econ. Syst. Reform* **2020**, 22–29. (In Chinese)
2. Li, X.; Cui, S.; Lai, X. Can digital finance enhance the value of listed State-owned enterprises?—Theoretical mechanism analysis and empirical test. *Mod. Financ. Econ. (J. Tianjin Univ. Financ. Econ.)* **2020**, *40*, 83–95.
3. Economic research on "high-quality development". *Chin. Ind. Econ.* **2018**, *4*, 5–18.
4. Huang, S.; Xiao, H.; Wang, X. On the high-quality development of State-owned enterprises. *China Ind. Econ.* **2018**, *35*, 19–41.
5. Wang, D.; Liu, L. Digital finance, Financial Mismatch and Total Factor Productivity of State-owned Enterprises: An analysis from the perspective of financing constraints. *Financ. Forum* **2021**, *26*, 28–38.
6. Xie, X.; Shen, Y.; Zhang, H.; Guo, F. Can digital finance boost entrepreneurship? Evidence from China. *Econ. Q.* **2018**, *17*, 1557–1580.
7. Tang, S.; Lai, X.B.; Huang, R. How does fintech innovation affect total factor productivity: Facilitating or inhibiting?—Theoretical analysis framework and regional practice. *Chin. Soft Sci.* **2019**, *11*, 134–144.
8. Li, Q.; Zhi, J.; Dang, Y. Digital finance, financing constraints and firm value. *Contemp. Financ. Res.* **2021**, *4*, 37–46.
9. Zhang, X.; Li, J. Digital finance, Financing Constraints and State-owned Enterprise Value: Based on the empirical data of China's A-share listed companies from 2011 to 2018. *Financ. Dev. Res.* **2021**, *39*, 20–27.
10. Ye, Y.; Wang, S. The mitigating effect of digital finance on corporate financing constraints. *J. Financ.* **2021**, *25*, 42–51.
11. Lu, X.; Lian, Y. Estimation of total factor productivity of Chinese industrial enterprises: 1999–2007. *Econ. Q.* **2012**, *11*, 541–558.
12. Guo, F.; Wang, J.; Wang, F.; Kong, T.; Zhang, X.; Cheng, Z. Measuring the Development of Digital Financial Inclusion in China: Index Compilation and Spatial Characteristics. *Q. J. Econ.* **2020**, *19*.
13. Hadlock, C.J.; Pierce, J. New evidence on measuring financial constraints: Moving beyond the KZ index. *Rev. Financ. Stud.* **2010**, *23*, 1909–1940. [CrossRef]
14. Wen, Z.L.; Zhang, L.; Hou, J.T.; Liu, H.Y. Mediating effect test and its application. *Acta Psychol. Sin.* **2004**, *5*, 614–620.
15. Xu, Q.; Chen, J.; Shou, Y.; Liu, J. Chinese firms' technological innovation: Portfolio innovation based on core competencies. *J. Manag. Eng.* **2000**, 1–9.
16. Zhang, J.; Hou, Y.; Liu, P.; He, J.; Zhuo, X. Objective requirements and strategic path of high-quality development. *Manag. World* **2019**, *7*, 1–7.
17. Liu, Y.; Liu, W. Executive tenure and R & D expenditure in Chinese listed companies. *Manag. World* **2007**, *22*, 128–136.
18. Wen, Z.; Zhang, L.; Hou, J. Mediating moderators and moderating mediators. *Acta Psychol. Sin.* **2006**, *50*, 448–452.
19. Hansen, B.E. Threshold Effect in non-dynamic Panels: Estimation, Testing and Inference. *J. Econom.* **1999**, *93*, 345–368. [CrossRef]
20. Berger, A.N.; Hasan, I.; Klapper, L.F. Further Evidence on the Link between Finance and Growth: An International Analysis of Community Bankingand Economic Performance. *J. Financ. Serv. Res.* **2004**, *25*, 169–202. [CrossRef]
21. Fu, W. Research on credit risk warning and prevention of small and medium-sized agricultural enterprises from the perspective of supply chain finance. *Guizhou Soc. Sci.* **2020**, *40*, 158–168.
22. Jiang, H.; Liu, Y. Digital finance, Supply chain Finance and Corporate financing constraints: Empirical evidence from SME board listed companies. *Technol. Econ. Manag. Res.* **2021**, *41*, 73–77.
23. Gillan, S.L.; Starks, L.T. Corporate Governance, Corporate Ownership, and the Role of Institutional Investors: A Global Perspective. *J. Appl. Financ.* **2003**, *13*. [CrossRef]
24. Zhen, H.; Wang, J. Can institutional investors ease financing constraints?—A perspective based on cash value. *Account. Res.* **2016**, *36*, 51–57.