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Digital Finance, Financing Constraints and Firm Value - An Empirical Analysis Based on A-share Coal Concept Listed Companies

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Abstract: *Digital finance is an important engine that accelerates the flow of funds, supports the efficiency of economic and social operation and promotes the healthy development of the economy, and has an important impact on the transformation and upgrading of SMEs and value-added. Using the fixed-effect model, the study of the impact of digital finance on the value of SMEs from the perspective of financing constraints found that: (1) the long-tail effect of digital finance can further promote the diversified and personalised development of the Coal industry. Digital finance can also provide financial support for emerging areas of the Coal industry, such as e-Coal and fitness industry.(2) The development of digital finance can promote the internationalisation of the Coal industry. Digital finance platforms can provide cross-border payment and remittance services for Coal enterprises, reducing the costs and risks of cross-border transactions.(3) While utilising digital financial services, Coal enterprises need to pay attention to risk management and compliance. Coal enterprises should strengthen their internal management, improve their risk management system, and prevent financial and operational risks.*

Key words: *digital finance; financing difficulties; Coal businesses; enterprise value*

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I. Introduction

Digital finance is the innovation and provision of financial services in an electronic and intelligent manner through digital technologies such as blockchain, artificial intelligence and big data, including online payments, digital banking, financial technology and blockchain technology applications. The policy, inclusive, technological and targeted characteristics of digital finance have enhanced the coverage of financial services, and are an important engine to accelerate the circulation of funds, support the efficiency of economic and social operation and promote the healthy development of the economy. As an emerging industry, Coal industry occupies an important position in modern economic and social development, and is the backbone of national economic development and full of innovation and vitality.

The realisation of enterprise value requires financial support, so there is an intrinsic link between enterprise value and financing status. The traditional theory of financing constraints points out that an increase in the degree of financing constraints will lead to a deviation from the optimal choice of the enterprise's investment decision, reduce the enterprise's investment efficiency, and inhibit the development of the enterprise. Existing research literature mostly supports that financing constraints are closely related to enterprise growth, but no unified conclusion has been drawn on the role of the relationship between the two.Zhang Yazhou et al. believe that the increase in the degree of financing constraints will inhibit the "qualitative" growth and "quantitative" improvement of enterprises, and curb the increase of enterprise value [1-5]. Ma Hong et al. pointed out that the financing constraints in China's strategic emerging industries have an inhibitory effect on the growth of the company, and the financing constraints have a significant negative impact on the value of the enterprise [6-11].

The Coal industry is characterised by high-risk and low-return finance, and it is difficult to obtain direct and indirect financial services from the market. Therefore, to provide financial investment and financing services for the Coal industry, we should deepen the reform of the financing mechanism of the Coal industry, on the one hand, to strengthen the government's non-market financial support to Coal for its high-risk and low-return characteristics, and on the other hand, to innovate the market-based financial support to Coal for the difficulty of obtaining direct and indirect financial services in the market through the market-based approach. To realise the financial service system of "government's action and market's efficiency", to eliminate the potential risk of "market failure and rent-seeking", and to provide new financial support for the growth of Coal industry and the formation of Coal industry clusters. The development of digital finance has changed the traditional

credit model, innovated the product service model, improved the efficiency of financial services, reduced financial risks, and brought important opportunities for the development of Coal enterprises by empowering the real economy. Digital technology-enabled financial innovation will be the main body of the business operation of all digital, transparent, so that financial institutions can be in-depth with the help of new technologies to provide direct financial services for Coal enterprises, effectively solve the problem of financing difficulties in Coal enterprises, financing and other issues. Whether the development of digital finance can empower the enhancement of enterprise value in the Coal industry and how the specific mechanism unfolds, this paper will empirically explore the transmission mechanism between "digital finance - financing constraints - Coal enterprise value" in order to provide references for Coal enterprises to achieve the digital transformation and This paper will empirically explore the transmission mechanism between "digital finance-financing constraints-Coal enterprise value" in order to provide reference for Coal enterprises to achieve digital transformation and high-quality development.

II. Theoretical Analysis and Research Hypotheses

2.1 Digital Finance and Coal Enterprise Value

Digital finance broadly refers to the use of digital technology by traditional financial institutions and Internet companies to achieve financing, payment, investment and other new financial business models. Digital finance refers to financial services that provide customers with capital financing, management, payment and so on through information technology. Digital finance is also financial in nature, and unlike traditional financial services, Internet finance provides customers with a richer experience, enabling them to have multiple choices. The development of digital finance is of great significance in supporting the operation of real enterprises, and digital finance is currently penetrating into all areas of society. The financial institutions and Internet companies represented by digital financial technology can well assume the role of hosting funds and investment risk control, and play a positive role in the policy guidance of investment projects so that they can better support the healthy development of the Coal industry in order to drive the development of the regional economy.

Based on the above, Hypothesis 1: There is a positive correlation between digital finance and the value of a Coal business is established.

2.2 Digital Finance, Financing Constraints and Firm Value

In digital finance research, scholars have likewise achieved rich results. Li Qinyang et[12] al. (2021) take listed enterprises as samples and find that digital finance enhances enterprise value through the channel of financing constraints; Ran Fang and Tan Yi (2021) [13]find that the development of digital finance accelerates the enterprise innovation investment, which in turn promotes the enhancement of enterprise total factor productivity, but this facilitating effect differs significantly among enterprises in different regions; Gao Xia et al. (2022)[14] study on industrial enterprises also concluded that the development of digital finance contributes to the growth of enterprises, and the results of mechanism analysis show that when the enterprise financing constraints are greater, the role of digital finance is greater; in addition, Love (2003), Sarma and Pais (2010), Li, Antelope and Huang, Xianjun (2022), Wan, Jiayu et[15-17] al. have also confirmed that the development of digital finance has a significant effect on enterprises to alleviate financing constraints and improve financing efficiency, and has an obvious role in promoting the suppression of corporate credit risk, promoting the development of corporate innovation, and enhancing corporate value. Drawing on the basis of existing research, this paper argues that digital finance has obvious advantages in easing financing constraints. Difficulty in financing has always

been a problem that inhibits the development of Coal enterprises, and the development of digital finance provides new ideas for the financing of Coal enterprises, which can effectively alleviate this problem to a large extent, reduce the actual cost of financing through the optimisation of the process, enhance the level of profits, and promote the healthy development of Coal enterprises.

Based on the above, Hypothesis 2: Financing constraints play a mediating role in the relationship between digital finance and the value of Coal firms.

III. Research design

3.1 Data Source

This paper selects 2011-2023 as the examination period and takes listed companies in the Coal industry as the research object. The raw data are processed according to the following methods: exclude ST and *ST enterprises, exclude enterprises with serious missing data, and finally obtain 10,621 sample observations. All continuous variables were truncated by 1% up and down by winsorize to eliminate the influence of extreme values of the sample data on the results, and Stata17 was used for descriptive statistics, correlation analysis and panel data regression.

3.2 Selection of variables

1. Explained variables：

Enterprise value (TobinQ). In this paper, we refer to the practice of Ping Wang and Qian Liu and use TobinQ value A as the proxy measure of Coal enterprise value. Where TobinQ value A = (market value of equity + market value of net debt) / total assets at the end of the period, where the market value of non-circulating equity is calculated by net assets instead.

2. Explanatory variables:

This paper refers to the "Peking University Digital Financial Inclusion Index (2011-2021)" compiled by a group formed by Peking University's Digital Finance Research Centre and Ant Technology Group Research Institute, and since the latest year of the time of this paper's examination is 2023, the index levelling method is done on the basis of the existing data of the Digital Financial Inclusion Index to compute the 2022 and 2023 digital Financial Inclusion Index. In this paper, the aggregate index of digital financial inclusion is taken as the core explanatory variable. Due to the problem that the value of the Digital Financial Inclusion Index is too large, the value is logarithmised in this paper.

3. Mediating variables:

This paper uses financing constraints as a mediating variable. Financing constraint is a non-directly obtained indicator, which is derived through comprehensive measurement. Currently, the mainstream research methods on financing constraints include KZ index, WW index and SA index. Based on the analysis of the structural level of indicator design, KZ index and WW index may have endogenous effects, so this paper borrows the practice of JU Xiaosheng, YAN Ruosen, LIU Li, QI Xiuhui, etc., and adopts SA to measure financing constraints in order to avoid the problem of endogeneity.

Calculated as SA = -0.737 x lnSize + 0.043 x lnSize2 -0.040 x Age

Where Size takes the natural logarithm of total assets and Age is the age of the firm.The smaller the SA index, the more severe the financing constraints faced by the firm.

IV. Empirical analyses

4.1 Descriptive statistics

As can be seen from Table 2, the mean value of enterprise TobinQ value is 2.1945, and the standard deviation is 1.2768, indicating that there is a large value gap between the sample observation enterprises. The mean value of Digital Finance Index DIFI is 2.3422, the maximum value is 3.1553, and the minimum value is 0.6073, indicating that digital finance has shown a rapid development in China in recent years, but the degree of development still exists a big difference between different regions. The mean value of financing constraints of each listed Coal enterprise is -3.6971, the maximum value is -3.2356, and the minimum value is -4.331, indicating that Coal enterprises generally face strong financing constraints.

Table 2 Descriptive statistics of variables

Variable	Mean	Sd	Max	Min	P25	P50	P75
TobinQ	2.1945	1.2768	8.1532	0.9617	1.4137	1.7982	2.601
DIFI	2.3422	0.6396	3.1553	0.6073	1.8631	2.5392	3.011
SA	-3.6971	0.2251	-3.2356	-4.331	-3.7691	-3.872	-3.489
Age	-3.7055	1.4878	-3.2248	-4.6271	0.4237	1.502	2.693
GA	16.1070	5.2187	31.2754	5.2113	11.898	14.982	18.892
CS	21.6129	0.9462	24.4783	19.9104	19.893	20.899	21.895
Cash	0.0390	0.0737	0.2003	-0.3429	0.0502	0.0172	0.0690
EC	0.3468	0.1846	0.8486	0.0452	0.1993	0.34211	0.487
Profit	0.1964	0.3556	1.9231	-0.5129	-0.0015	0.122	0.299
Exp	1.5629	3.4852	2.8900	3.5400	1.0700	3.9800	4.3200

4.2 Correlation analysis

The correlation coefficient between the mediator variable SA and the explained variable TobinQ is 0.042, there is a significant positive correlation; basically, there is a more significant correlation between the control variable and the explained variable TobinQ.

Table 3 Results of correlation analysis between variables

Variable	TobinQ	DIFI	SA	Age	GA	CS	Cash	EC	Profit	Exp
TobinQ	1.000									
DIFI	0.029***	1.000								
SA	0.042***	-0.402***	1.000							
Age	0.332***	0.502***	0.368***	1.000						
GA	0.017*	0.403***	-0.913***	0.019**	1.000					
CS	0.208***	0.212***	-0.216***	0.170***	0.114***	1.000				
Cash	0.116	0.069***	0.453***	0.221***	0.091***	-0.0071	1.000			
EC	2.01***	0.152***	-0.122***	0.401***	0.060***	0.491***	-0.0071	1.000		
Profit	0.037***	-0.001	-0.030***	-0.143***	-0.071***	0.112***	0.492***	0.044***	1.000	
Exp	-0.021***	-0.152***	-0.082***	-0.089***	-0.079***	-0.0037	0.197***	-0.029***	-0.005	1.000

Note: *, **, *** indicate significant at the 10 per cent, 5 per cent and 1 per cent statistical levels, respectively.

4.3 Robustness Tests

Replacing explanatory variable measures. Some papers propose that the breadth of digital financial coverage (COV) and the depth of digital financial use (USE) represent digital finance (DIFI). Since the research object of this paper is Coal enterprises, which represent a small part of enterprises in many industries, the use of digital financial coverage breadth (COV) is not very meaningful for its research. Therefore, using the depth of use of digital finance (USE) instead of digital digital finance (DIFI) to re-regress can be, the specific results are shown in Table 6.

Table 6 Robustness tests

Variable	（1） *SA*	（2） *TobinQ*
USE	0.0124*** (5.29)	0.226*** (4.69)
SA		2.412*** (14.81)
Age	-0.0392*** (-292.53)	0.1411*** (14.50)
GA	-0.0086*** (-3.75)	0.1332*** (3.62)
CS	-1.969*** (2,87)	0.279*** (3.57)
Cash	0.1622*** (2.91)	0.481*** （4.21）
EC	0.009*** （4.72）	-0.0021** （-2.11）
Profit	0.441*** （5.382）	0.549*** (3.120)
Exp	-1.988 (-1.031)	-2.380 (-1.272)
Constant	-2.4381*** (-81.6)	13.142*** (21.103)

Year	Control	Control
Industry	Control	Control
Observations	10621	10621
R-squared	0.205	0.321
r2_a	0.207	0.330

Note: *, **, *** indicate significant at the 10 per cent, 5 per cent and 1 per cent statistical levels, respectively.

As can be seen in Table 6, the regression coefficients of the key variables are still more consistent with those listed in Table 5 after replacing the explanatory variables. In column 2 of Table 6, the regression coefficient of the depth of use of digital finance USE is 0.2262, and the regression coefficient of the SA index of financing constraints is 2.4166, both of which are significantly and positively correlated with the TobinQ of enterprise value at the level of 1%, which suggests that the enhancement of the depth of the use of digital finance can alleviate the constraints of financing and thus promote the enhancement of the value of Coal enterprises. The direction of the robustness test and the size of the regression coefficients are consistent with the regression results shown in Table 5, indicating that the depth of use of digital finance has a significant supportive effect on the financing of Coal enterprises, and promotes the performance and value enhancement of enterprises. The regression coefficients of USE and SA index on enterprise value are 0.2262 and 2.4166 respectively, and the regression coefficients of GA and EC on enterprise value are -0.0086 and 0.009 respectively, all of which are significant at 1% level and consistent with the previous regression results. Therefore, the results of empirical analyses in this paper are robust, reasonable and reliable.

V. Conclusions of the reasearch

The thesis mainly investigates the mechanism of "the impact of digital finance on the value of Coal enterprises", focusing on the role of digital finance in alleviating the problem of financing difficulties. The results show that there is a significant positive relationship between digital finance and the value of Coal enterprises, while financing constraints play a mediating role in the relationship.

Based on the research findings, this paper draws the following insights:
(1) The long-tail effect of digital finance can further promote the diversified and personalised development of the Coal industry. The digital finance platform can provide financing channels for small, medium and small-sized Coal enterprises and promote their development and growth. At the same time, digital finance can also provide financial support for emerging areas of the Coal industry, such as e-Coal and fitness industry.
(2) The development of digital finance can promote the internationalisation of the Coal industry. The digital finance platform can provide cross-border payment and remittance services for Coal enterprises and reduce the cost and risk of cross-border transactions. At the same time, digital finance can also provide financing support for the international expansion of Coal enterprises and promote them to the international market.
(3) While utilising digital financial services, Coal enterprises need to pay attention to risk management and compliance. Coal enterprises should strengthen internal management, improve the risk management system, and prevent financial risks and operational risks. At the same time, Coal enterprises also need to comply with relevant laws and regulations to ensure compliant operation, to avoid being punished and affecting the corporate image due to irregularities.
Digital finance has an important role in promoting the development of Coal enterprises, but Coal enterprises need to pay attention to risk management and compliance while using dig.

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