



Research on the Impact of Digital Finance on Enterprise Environmental Protection Investment

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Abstract. Based on Panel data of A-share listed companies in Shanghai and Shenzhen and provincial Panel data of digital finance in 2011-2021, this paper uses fixed effect, Mesomeric effect and other models to conduct empirical analysis, and examines the impact of digital finance on corporate environmental protection investment. Research has shown that (1) Digital finance has a significant promoting effect on corporate environmental investment. (2) Mechanism analysis shows that digital finance promotes environmental investment by reducing supplier concentration. (3) Heterogeneity analysis shows that the nature of property rights and audit opinions have heterogeneity in the relationship between digital finance and environmental investment in enterprises. Digital finance has a greater promoting effect on environmental investment in private enterprises and enterprises issuing non-standard audit opinions. Therefore, this paper discusses the impact of digital finance on corporate environmental protection investment from the perspective of digital finance, and provides Empirical evidence for promoting high-quality sustainable development of Chinese enterprises.

Keywords: Digital finance; Environmental protection investment; Low-carbon economy; Mechanism test

1 Introduction

Recently, Chinese economy has developed rapidly, but environmental pollution has become increasingly serious. As one of the main manufacturers of environmental pollution, enterprises are the first to bear the responsibility of environmental protection[1]. In the 14th Five Year Plan for National Economic and Social Development of the China and the Outline of Vision Goals for 2035, the word "green" has appeared 50 times in total. "Promoting green development, promoting harmonious coexistence between man and nature" has been explained separately, which specifically includes three parts: improving the quality and stability of the ecosystem, continuously improving the environmental quality, and accelerating the green transformation of the development mode. It

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can be seen that the country has long attached great importance to environmental protection and green development, and it is the trend for enterprises to invest in environmental protection.

Finance is an important core competitiveness of a country[2]. In the process of achieving green development, the important role of finance should be fully utilized[3]. In recent years, the vigorous development of digital finance has provided possibilities for promoting green transformation of enterprises. Digital finance, through the combination of digital technology and financial products, compensates for the shortcomings of traditional financial services, lowers the threshold for financial services, promotes the transformation of traditional financial institutions, improves the efficiency of financial markets, and is of great significance in promoting innovation. Digital finance is a new model derived from the combination of innovative technology and traditional finance in the digital era. Its inclusive, inclusive, and innovative characteristics will have a profound impact on the development of China's real economy and will have a positive impact on achieving green and sustainable development of China's economy. In summary, digital finance, supported by digital technology and integrated with the traditional financial industry, undoubtedly has significant implications for manufacturing enterprises to invest in environmental protection.

Based on this, this paper uses the Panel data of Shanghai and Shenzhen A-share listed companies from 2010 to 2021 to match the provincial Panel data of digital finance published by the Digital Finance Research Center of Peking University, and comprehensively explores the impact of digital finance on corporate environmental protection investment. Compared with existing literature, the potential academic contribution of this article mainly lies in the fact that, unlike previous scholars who have focused on studying the development status of digital finance in the financial field and its significant significance for the development of the real economy, this article explores from the perspective of whether digital finance can promote corporate environmental investment.

2 Theoretical analysis and research hypotheses

2.1 Digital Finance and Enterprise Environmental Protection Investment

The main goal of digital finance is to serve the real economy (where manufacturing plays an important role), and as a new model developed through digital technology, digital finance generates greater benefits in terms of operation mode, market manipulation, and transaction work compared to traditional financial industries serving the real economy. The vast majority of people in the current academic community acknowledge that digital finance has a positive promoting effect on the high-quality development of the manufacturing industry. And digital finance provides a positive promoting effect by promoting its industrial innovation. Digital finance applies advanced digital technology to the traditional financial industry. It is an innovation of financial products, financial models and financial systems that promotes the innovation of the financial industry, and Financial innovation is significantly positively correlated with technolog-

ical progress[4]. Digital finance first drives enterprise innovation through its own innovation, and secondly, through the use of digital information technology, quickly identifies the financial demand characteristics of green innovation projects, solves the financial supply problem of green innovation systems, and provides financial support for the innovation and digitization of environmental protection technology in enterprises. Digital finance provides financial support for the development of environmental protection technology in enterprises, and the inclusivity brought by digital finance can indirectly provide funding for environmental protection technology in manufacturing enterprises by alleviating corporate financing and other means. Therefore, it can be inferred that digital finance has an increasing impact on the funding required for the environmental protection industry of manufacturing enterprises. Therefore, this article proposes the following assumptions:

Hypothesis 1: Digital finance has a positive promoting effect on environmental investment by enterprises.

2.2 Supplier concentration positively regulates corporate environmental investment by suppressing digital finance

Innovation and development are currently one of the main themes of the times, and under the background of "dual carbon", enterprises are mainly targeting the development of environmental protection industries and technological green innovation and transformation. By promoting environmental innovation, we aim to achieve the transformation of the enterprise economy into a green economy. Digital Financial inclusion also provides financial guarantee for the environmental protection industry innovation of enterprises. By easing its financing constraints and solving the economic supply problems in its innovation system, it can guarantee and promote the increase of the output value and investment of the environmental protection industry of manufacturing industry. In the current era where companies are expected to achieve green innovation, the degree and scope of green innovation will also be closely monitored by their industry suppliers. Because green innovation, as one of the current innovation priorities and transformation methods for enterprises, accounts for a large proportion of internal core resources, requires high funds, and takes high risks, all of which can increase the risk of enterprise survival to a certain extent. At this point, the higher the concentration of suppliers, the greater their self-protection awareness of unwillingness to bear additional unknown risks, which will form greater resistance to green innovation of enterprises and rely on the academic "capital dependence theory"[5]. In summary, this study proposes the following assumptions:

Hypothesis 2: Digital finance will drive enterprises to implement environmental investment by reducing supplier concentration.

3 Research design

3.1 Sample Selection and Data Sources

This paper selects listed companies in China's Shanghai and Shenzhen A-shares from 2011-2021 as the research object and does the following screening as needed: first: exclude ST, *ST and PT category companies; second: exclude sample data of undisclosed environmental protection investment; third: exclude samples with missing financial data, and finally obtain 3,249 sample observations. In addition, this paper has done the following pre-processing on the data. First: to avoid the influence of extreme values on the empirical results, this paper has done tail-shrinking on all continuous variables at the 1% and 99% quartiles. Second: To mitigate the effects of potential heteroskedasticity and autocorrelation, all corrections are made in this paper using robust standard errors.

The data sources in this paper are as follows: (1) Digital finance data are derived from the Digital Inclusive Finance Index jointly published by the Digital Finance Research Centre of Peking University and Ant Financial Services, in which the indicators for the number of Internet practitioners are mainly derived from the China City Statistical Yearbook; digital finance is measured using the provincial digital inclusive finance index in China compiled by Guo Feng et al. (2020)[6]. The sources of corporate environmental investment and other corporate governance variables and financial data are the CSMAR database and the WIND database.

3.2 Model Setting

Baseline regression models (1) and (2) are first constructed to verify the impact of the digital economy on the ESG behaviour of firms, with the following expressions:

$$EI_{i,t} = \alpha_0 + \alpha_1 DF_{i,t} + \gamma_{i,t} + \mu_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$EI_{i,t} = \varphi_0 + \varphi_1 DF_{i,t} + \sum_k \varphi_k Controls_{i,t} + \gamma_{i,t} + \mu_{i,t} + \varepsilon_{i,t} \quad (2)$$

Where i denotes an individual firm and t denotes the year. The explanatory variable $EI_{i,t}$ denotes the environmental investment of firm i in period t . $DF_{i,t}$ denotes the digital finance index of the province in which firm i is located in period t . In addition, this paper also selects control variables for firm value along several dimensions, mainly including financial indicators measured by $FIXED_{i,t}$, $ROA_{i,t}$, $ATO_{i,t}$, $Balance_{i,t}$, $FirmAge_{i,t}$, $Board_{i,t}$, $BMI_{i,t}$, $Growth_{i,t}$, $Occup_{i,t}$. Annual dummy variable (γ_t) and industry dummy variable (μ_i) are also included in the model to control for unobservable or time-varying influences.

4 Empirical analysis

4.1 Descriptive statistics of variables

The descriptive statistical characteristics of the variables in this paper are shown in Table 1. The mean value of environmental protection investment (EI) is 14.49 and the median value is 14.61, the mean and median values are basically the same, which indicates that the distribution of environmental protection investment (EI) of the sample enterprises is more symmetrical. In contrast, the maximum and minimum values of digital finance (DF) were 462.2 and 7.58 respectively, with the difference between the maximum and minimum values reaching 50 times, indicating that the level of development of digital finance varies widely across Chinese provinces.

Table 1. Descriptive Statistics

	Variables	N	Mean	Min	Max	Me- dian	SD	Vari- ance
Dependent variable	EI	3249	14.49	3.892	20.15	14.61	1.889	3.567
Independent variable	DF	3249	307.2	7.580	462.2	334.6	117.4	13778
Control var- iables	Size	3249	22.54	19.55	26.41	22.41	1.265	1.601
	FIXED	3249	0.303	0.002	0.725	0.281	0.161	0.026
	ROA	3249	0.035	-0.398	0.254	0.031	0.064	0.004
	ATO	3249	0.662	0.053	2.902	0.573	0.415	0.172
	Balance	3249	0.314	0.006	1	0.218	0.283	0.080
	FirmAge	3249	2.902	1.386	3.611	2.944	0.315	0.099
	Board	3249	2.165	1.609	2.708	2.197	0.194	0.038
	BM	3249	1.264	0.051	10.14	0.869	1.220	1.489
Growth	3249	0.159	-0.660	4.330	0.088	0.421	0.177	

4.2 Benchmark regression results

Table 2 shows the test results of the baseline regression model in this paper and thus verifies that research hypothesis 1 holds. The specific analysis is as follows:

Column (1) of Table 2 shows the regression results with the inclusion of only the core explanatory variable, digital finance. This result shows that digital finance positively contributes to corporate environmental investment at the 1% level of significance.

Column (2) in Table 2 shows the regression results with the inclusion of control variables. The results show that digital finance positively contributes to corporate investment in environmental protection at the 1% significance level, i.e. in provinces where digital finance is better developed, it enhances corporate engagement with stakeholders and leads to better corporate social responsibility, thus enhancing corporate

performance in environmental investment and realising the non-economic value creation of digital finance.

Table 2. Regression Results of the Impact of Digital Finance on Enterprise Environmental Protection Investment

	(1) EI	(2) EI	(3) CS	(4) EI
DF	0.005*** (4.663)	0.005*** (4.349)	-0.008* (0.631)	0.005*** (4.295)
CS				-0.005** (-2.376)
Size		0.670*** (11.605)	-8.326*** (-11.293)	0.606*** (8.858)
FIXED		0.819*** (3.323)	-7.718** (-2.495)	1.096*** (3.930)
ROA		-1.001** (-2.414)	1.052 (0.211)	-1.140** (-2.541)
ATO		0.219* (1.913)	-2.918* (-1.951)	0.264** (1.963)
Balance1		-0.245* (-1.861)	3.030* (1.788)	-0.188 (-1.230)
FirmAge		1.557*** (4.087)	4.904 (0.940)	1.298*** (2.766)
Board		0.386** (2.012)	-0.380 (-0.165)	0.450** (2.168)
BM		-0.100*** (-2.818)	0.103 (0.233)	-0.122*** (-3.061)
Growth		-0.088* (-1.809)	0.735 (1.246)	-0.130** (-2.450)
Ind	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
_cons	12.931*** (37.976)	-7.525*** (-4.373)	209.916*** (9.193)	-5.734*** (-2.735)
N	3155.000	3155.000	2576.000	2576.000
r2 a	0.744	0.759	0.727	0.771

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

4.3 Mechanism test

The previous analysis shows that digital finance promotes corporate environmental investment. Next, this paper will focus on the mechanisms by which digital finance promotes corporate environmental investment. The results of the fixed effects show that the development of digital finance can significantly reduce supplier concentration (CS), and that firms are less dependent on suppliers due to increased access to information, i.e. the development of digital finance enables firms to better spread upstream costs, improve the stability of their sales channels, and thus become more comfortable in making environmental investments. Thus, digital finance will promote corporate environmental investment behaviour by reducing supplier concentration. Tables 2(3)-(4)

present the results of this paper's mechanism test model and thus verify that research hypothesis 2 holds. The specific analysis is as follows:

In order to verify the mechanistic effect of digital finance in promoting corporate environmental investment, as follow:

$$EI_{i,t} = \varphi_0 + \varphi_1 DF_{i,t} + \sum_k \varphi_k Controls_{i,t} + \gamma_{i,t} + \mu_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$CS_{i,t} = \alpha_0 + \alpha_1 DF_{i,t} + \sum_k \varphi_k Controls_{i,t} + \gamma_{i,t} + \mu_{i,t} + \varepsilon_{i,t} \quad (5)$$

$$EI_{i,t} = \delta_0 + \delta_1 DF_{i,t} + \eta CS_{i,t} + \sum_k \varphi_k Controls_{i,t} + \gamma_{i,t} + \mu_{i,t} + \varepsilon_{i,t} \quad (6)$$

Where i denotes an individual firm and t denotes the year. The variable $CS_{i,t}$ denotes the supplier concentration of Shanghai and Shenzhen A-share listed companies' i in period t . The results of the mediating effect test are shown in Table 2. Columns (3)-(4) show the results of the test with supplier concentration as a mediating variable, where digital finance in column (3) is significantly negative at the 10% level, indicating that digital finance reduces supplier concentration. Column (4) of digital finance promotes firms' environmental investment behaviour is significant at the 1% level and supplier concentration is significant at the 5% level, revealing that digital finance will promote firms to implement environmental investment by reducing supplier concentration.

5 Conclusion

This paper uses panel data of Shanghai and Shenzhen A-share listed companies from 2010-2021 matched with provincial panel data on digital finance published by the Digital Finance Research Centre of Peking University to comprehensively explore the impact of digital finance on corporate environmental protection investment. The study finds that digital finance has a significant positive contribution to manufacturing enterprises' investment in environmental protection. Real economic development positively moderates the role of digital finance on manufacturing firms' environmental investments. The analysis of property rights heterogeneity shows that the positive promotion effect of digital finance on environmental protection investment of manufacturing enterprises is more significant in non-state enterprises than in state enterprises. Audit opinion heterogeneity shows that the positive effect of digital finance on environmental investment in manufacturing enterprises is more significant in manufacturing enterprises with high audit quality. Based on the above findings, the author proposes corresponding policy implementation recommendations.

At present, digital financial platforms still need to rely on traditional finance, and the government can establish a perfect collaboration between digital finance and traditional finance to fully promote enterprises to carry out green innovation and complete green transformation. The government should play a macroscopic role and use its "visible hand" to carry out supervision, management and regulation functions, improve management and regulation efficiency, build and implement relevant policies, and establish an efficient operation system. The central government has taken the lead in formulating policies to encourage SMEs to promote the deeper use of digital finance products and product optimisation to achieve lower pollution emissions, while providing supporting

measures for enterprises to reduce pollution emissions with digital finance to improve the efficiency of emission reduction and promote green development. Changes to the financial system to establish a green and efficient financial system, prevent financial risks while promoting green innovation, and achieve a balance between the two. Also expand the coverage and frequency of use of digital finance to provide more technical support for digital finance and promote its green development.

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References

1. Xu Xiaofeng, Zhang Wenyan, Wang Tao, Xu Yi & Du Huanzheng. (2021). Impact of subsidies on innovations of environmental protection and circular economy in China. *Journal of Environmental Management*. doi:10.1016/J.JENVMAN.2021.112385.
2. Woehler Julia & Ernst Cornelia. (2023). The importance of marketing mix planning and customer orientation for venture capital–financed startups: impacts on valuation, performance, and survival. *Journal of Research in Marketing and Entrepreneurship*. doi:10.1108/JRME-08-2021-0098.
3. Wang Weiwei, Gao Pengpeng & Wang Jiahaoran. (2023). Nexus among digital inclusive finance and carbon neutrality: Evidence from company-level panel data analysis. *Resources Policy*. doi:10.1016/J.RESOURPOL.2022.103201.
4. Shen Yuchen & Ren Xiaoping. (2023). Digital finance and upgrading of industrial structure: Prefecture-level evidence from China. *Finance Research Letters*. doi:10.1016/J.FRL.2023.103982.
5. Mejia Steven Andrew. (2021). Does foreign capital dependence affect carbon dioxide emissions in less-developed countries? A cross-national analysis, 1980–2014. *Social Science Quarterly*. doi:10.1111/SSQU.13034.
6. Feng Guo, Jingyi Wang, Fang Wang, Tao Kong, Xun Zhang & Zhiyun Cheng. (2020). Measuring the development of digital inclusive finance in China: indexing and spatial characteristics. *Economics (Quarterly)* (04), 1401-1418. doi:10.13821/j.cnki.ceq.2020.03.12. (In Chinese)

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