

The Study of The Impact of Digital Finance on Corporate Green Investment

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Abstract: Green investment is an important way to strengthen pollution control and improve environmental quality. In recent years, in the rapid development of the economy at the same time, China is facing the serious problem of serious environmental pollution and lack of resources, change the mode of development, construction of a set of innovation, wisdom, high efficiency, green as one of the development model has become the future of China's enterprise development strategy of a major shift. In the future development of enterprises, green investment is a crucial part of breaking the traditional development model that has long relied excessively on high inputs, high pollution and high emissions, and shifting to a green and high-quality development model that relies more on technological advancement, efficiency improvement, and pollution and carbon reduction. Compared with traditional finance, digital finance expands the breadth and depth of financial development, and is a more sustainable, environmentally friendly and efficient mode of financial development, which may be able to become an important engine for corporate green investment. Based on the data of Chinese listed companies from 2011-2021, this paper studies the impact of digital finance development on corporate green investment. The empirical results show that digital finance significantly increases firms' green investment, and this conclusion still holds after a series of robustness tests.

Keywords: Digital finance, Corporate green investment, Financing constraints, Financial development.

1. Introduction

Enterprises are the main producers of carbon emissions, and expanding the scale of corporate green investment is of great significance to realising China's economic green transformation and improving environmental governance. As a corporate social responsibility activity, green investment is the key to maximising economic value and social benefits. However, corporate green investment is a high-cost activity that requires large capital investment and diversified financing sources. At the same time, Chinese enterprises pay more attention to short-term economic performance, resulting in a generally low level of corporate green investment. At present, how enterprises can follow the trend of the times and find an important engine for green investment, and then shift to a more sustainable, lower carbon and more efficient green development mode, is currently the top priority for the green transformation of enterprises.

The development of digital technology has given rise to the digital financial model, which creates a new platform for enterprises to improve the efficiency of capital factor allocation, broaden lending channels and obtain financial support for green investment. In the context of the development of new technologies, exploring the impact of digital finance on corporate green investment is crucial to promoting green economic growth. In recent years, the Internet revolution has brought diverse impacts to the global economy and human life. Over the past few years, digital finance in China has shown a pattern of rapid development. From the birth of Alipay to the full popularity of mobile payments, China has been at the forefront of digital financial development. By the end of 2021, the number of mobile payment users in China had exceeded 800 million, and the scale of mobile payment transactions had exceeded 200 trillion yuan. As a new model of traditional finance empowered by technology, digital finance can solve the problem of mismatch between financial services and real

economic resources. This innovative financial model can help break several bottlenecks faced by enterprises in green investment. The essence of digital finance is still financial services, and it is a resource-saving and environmentally friendly financial service that keeps pace with the times. As an important embodiment of green transactions, digital finance can make full use of digital technology to bring traditional financial services online. At present, the biggest dilemma of green investment comes from financing constraints, as it is characterised by a long payback period, high investment risks, and information asymmetry between investors and enterprises. Traditional financial institutions are less willing to lend to high-risk, low-return green investment projects. Digital finance, however, can provide efficient and convenient financial services, lower the barrier to entry, significantly reduce transaction costs, and provide new ways to alleviate the company's funding gap, reduce financial risks, and break through technological bottlenecks.

In terms of enterprise development, first, the development of digital finance enhances the level of technological innovation of enterprises. Wan Jiayu et al. (2020) empirical study found that digital finance can significantly alleviate the financing constraints of enterprises, and then promote enterprise innovation, and for small and medium-sized enterprises and private enterprises, the innovation incentive effect of digital finance will be stronger. Xie Xueyan et al. (2021) take SMEs listed on the New Third Board as samples, and find that the development of digital finance significantly promotes technological innovation of SMEs by increasing R&D investment, improving profitability, and easing credit constraints, and based on the functional view, they find that the functions of digital finance such as payment, insurance, money fund, and credit business significantly promote technological innovation. Based on the sample data of A-share listed companies, Shin Ho et al. (2022) empirically found that digital finance can significantly enhance the innovation performance of enterprises. And enterprise size,

the degree of government innovation subsidies, and industry characteristics all affect the positive effect of digital finance on enterprise innovation. Second, the development of digital finance helps to promote the green development of enterprises. Zhai Huayun et al. (2021) empirical study found that digital finance can effectively enhance the quantity and quality of enterprise green innovation. Jiang Jianxun et al. (2022) empirical results show that digital finance significantly promotes green innovation of new energy enterprises by alleviating financing constraints. Third, the development of digital finance helps to improve the quality of enterprises, Chen Zhongfei and Jiang Kangqi (2021) empirical study found that the development of digital finance significantly improves the total factor productivity of enterprises.

At present, the external influencing factors of enterprise green investment mainly include environmental regulation. The external influencing factors of enterprise green investment include environmental regulation, media attention, public pressure and so on. From the perspective of environmental regulation, the

Bixi and Yu Lianchao (2016) further concretise environmental regulation, finding that when enterprises face environmental taxes and sewage charges levied by the government, they will increase the investment of green funds to control pollutant emissions, and introduce energy-saving and emission reduction technologies and equipments to improve the efficiency of resource utilisation, all of which will increase the level of green investment of the enterprises themselves. From the perspective of media attention, the media plays an important supervisory function in the green investment behaviour of enterprises. Zhang Jijian et al. (2016) empirical study found that media supervision can promote the role of environmental regulation on corporate green investment, and the role of positive reports on corporate green investment is more obvious compared to negative reports. From the perspective of public pressure, Zhou Yana et al. (2021) argue that analyst attention can significantly promote corporate green investment. Analysts, as a professional supervisory force, represent the interests of investors, and the increase in analyst attention enhances the scope and intensity of society's supervision of enterprises, prompting management to increase corporate green investment in order to establish and maintain a good reputation.

2. Characteristics and Challenges of Digital Financial Development

In terms of temporal characteristics, the Total Digital Finance Index shows a year-on-year increase from 2011-2021, achieving a combination of high-speed and high-quality development over the past decade or so. The median of the total digital finance index grows from 33.6 in 2011 to 363.6 in 2020, an increase of more than ten times. In terms of growth rate, the growth rate of digital finance shows a trend of continuous slowdown. In particular, after years of rapid development, the digital finance index has already had a certain scale in China, so it has shifted to a stable and normalised growth.

However, the sub-index of digital finance still shows an incremental trend overall, with only individual years showing regression, such as a decline in the digitisation of digital finance in 2016 and 2017, and a decline in the depth of use of digital finance in 2014 and 2018, while the breadth of coverage of digital finance has shown a steady upward trend.

In terms of the development speed of the sub-index, the growth of the digitisation degree of digital finance was the fastest before 2015, and its growth rate declined after 2015, and the growth rate of the depth of use of digital finance after 2015 gradually caught up with the breadth of coverage. Therefore, deepening the degree of digitisation and depth of use of digital finance on the basis of continuously expanding the breadth of coverage is the basic logic of the development of digital finance. Moreover, the breadth of coverage and degree of digitisation of digital finance have already reached a high level, and digital finance should pay more attention to the depth of use if it is to play a greater role.

In terms of regional differences, Beijing, Shanghai and Jiangsu and Zhejiang are in the first echelon of digital financial development, while Tibet, Ningxia, Inner Mongolia, Xinjiang, Jilin, Guizhou, Heilongjiang, Gansu and Qinghai are lagging behind, and are in the third echelon of digital financial development, which is behind the general level of the country. Obviously, the lagging provinces are all in the western and northeastern regions of China, while other provinces are at the middle level.

In terms of regional differences in the sub-indexes, regional differences in the degree of digital support are the smallest, with the highest province being 1.36 times that of the lowest; and regional differences in the depth of use are the largest, with the highest province being 1.89 times that of the lowest. Although the regional difference in the depth of use of digital finance has been significantly reduced after 2021, it is still the main factor contributing to regional differences in digital finance. In the specific industry, the regional differences in Internet investment are significantly higher, which is determined by the characteristics of digital finance itself, it is relatively easy to promote the use of digital finance, but it still takes a long time to follow up on how to make more people trust digital finance and then use it extensively. Overall, there are obvious regional differences in the development of digital finance, but the regional differences are decreasing, and whether the future can continue to eliminate the gap between regions mainly depends on whether the depth of use can reduce the differences between regions. In terms of North-South differences, the gap between the level of digital financial development in the North and the South of China has narrowed rapidly, but the changes in the past two years have been relatively small; the current differences in digital financial development between the North and the South mainly stem from the gap in the depth of use.

The development of digital finance is relatively short, still in its infancy, and there is less international experience to draw on, so China's digital finance is facing problems and challenges in several areas.

The first is the issue of information security on the Internet. Digital finance is closely integrated with the Internet, which is itself subject to great uncertainty and risk. The core of digital finance is digitisation, so it combines consumers' personal information, the security of the Internet, and the security of funds, and once the lawless elements come into contact with the information resources and tamper with them, it will bring huge losses to the user and the service provider; from Alipay and Jingdong Finance collecting third-party information from users' mobile phones for resale and the resulting financial fraud, we are reminded of the importance of the user's information security. The importance of user information security is being reminded. In addition, Internet

fraud in the form of Internet wealth management, P2P lending and other forms of Internet fraud drink up the panic of the community.

Secondly, it is difficult to regulate. Digital finance has penetrated into all walks of life, giving rise to a wide variety of financial forms, while its corresponding risks are also more likely to be transferred and spread among industries, bringing about greater damage. How to avoid the occurrence of cross-regulation, regulatory arbitrage, regulatory gaps and other phenomena still requires further exploration.

Thirdly, there is a lack of an effective credit collection system. China's credit collection system is relatively late in construction, and is still dominated by the People's Bank of China's Credit Collection Centre, which is the largest credit collection agency in the country, but the coverage of credit collection data is only 35%, and the coverage of personal credit collection is only 61%, which is far lower than that of other countries in the international arena. Moreover, many people are not included in the credit system, in which case the backward credit collection leads to backward information assessment, and it is impossible to provide targeted services or products for users, which in turn hinders the development of digital finance.

3. Mechanisms for the Direct Impact of Digital Finance on Corporate Green Investment

First, digital finance can innovate traditional finance and promote the green development of enterprises. Finance, as the core of the modern economic system, can achieve the rational use of funds and improve the efficiency of capital allocation, thereby promoting the green transformation of enterprises and enhancing efficiency. However, in the process of serving enterprises, there are obvious structural mismatches in traditional finance, centred on the three aspects of "attribute mismatch", "field mismatch" and "stage mismatch". The development of digital finance can effectively correct the three major structural mismatches existing in traditional finance, and make the funds more reasonably allocated and used in the green investment projects of enterprises. On the one hand, the development of digital finance, through the dual innovation of finance and technology, not only deepens the integration of digital technology and industrial chain, but also promotes the digital transformation and intelligent transformation of traditional industries, which in turn reduces the consumption of resources and pollution emissions, and makes the enterprises tend to be more advanced and rational development. On the other hand, digital finance, through its own technological advantages, can effectively alleviate information asymmetry, so that clean, environmentally friendly and other industry enterprises can also obtain the same financial resources as the key enterprises with high consumption and high pollution, reducing the mismatch of financial resources. The supply of traditional financial services is difficult to meet the needs of enterprises in terms of quantity and quality, and digital finance, as a kind of financial spillover, can to a certain extent drive the reshaping of the traditional financial system, gradually build algorithms and big data warehouses for soft information of hardened manufacturing enterprises, force the transformation and upgrading of the traditional financial structure, improve the efficiency of financial resource allocation, strengthen the risk management ability of enterprises, and put efficient products

and services into the to enterprise green investment projects, and promote enterprise green investment.

Secondly, digital finance can provide enterprises with innovative financial services. Digital finance, empowered by digital technology, can innovate the traditional financial system, reduce transaction costs and improve financial efficiency, thus providing a new impetus for green investment by enterprises and becoming a new driving force to promote green development of enterprises. The development of digital finance in China started with the launch of the Alipay account system, which has since opened up the process of the Internet and information technology changing China's financial business model. With the rise of digital finance, Internet companies have begun to deeply participate in the traditional financial system, using artificial intelligence, big data, blockchain and other new technologies to change the structure of the traditional financial industry, provide better financial products and services, and greatly reduce the cost of searching for and identifying risks in the financial market, which in turn provides opportunities for green investment by enterprises. Digital finance continues to tap new business growth points and business models, further enriching the connotation of finance and enhancing the efficiency of resource allocation. Digital finance provides enterprises with more efficient and convenient digital financial services, effectively reduces the transaction costs of enterprises, supports green investment projects in a more targeted manner, and improves the level of green investment of enterprises.

Thirdly, digital finance has developed into an environmentally friendly financial model. Embedded in blockchain, big data and other emerging technologies, digital finance helps innovate traditional financial institutions, guides the inter-temporal allocation of financial factors, improves the circulation efficiency of resources within the economic system, makes the exchange of factors between regions and industries faster and more convenient, and extends the coverage of finance. At the same time, the development of digital finance, through the combination of finance and artificial intelligence, cloud computing, blockchain and other technologies, the unstructured, non-standardised massive information for the collection, classification, analysis and decision-making, can effectively reduce the transaction costs of financial services, at the same time, the Internet platform of the non-contact transaction makes the traditional business processing in the resource consumption is greatly reduced. And digital finance, as a new business model, can give rise to related new industries and new modes, promote the green transformation and upgrading of enterprise products, and promote green investment through the resulting competitive market effects. Corporate social responsibility is part of a company's long-term strategic choice, as it can bring competitive advantage, reputation and strategic gains. Digital finance not only creates a "technological dividend" and provides financial support for corporate green technological breakthroughs, but also intensifies market competition and increases the incentives for heavily polluting enterprises to make green investments, thereby enhancing the social responsibility of environmental enterprises.

Fourth, digital finance can use the reputation effect to promote corporate green investment. Specifically, the reputation effect can influence corporate green investment behaviour from both external and internal channels. External

reputation effect is mainly through the transmission of information under the competitive market to weaken the information asymmetry, to produce an effective evaluation mechanism, so as to influence the decision-making of managers, management based on the pressure of social governance responsibility, will increase the capital investment in green investment. That is, digital finance with the help of big data and other technologies to mine and disclose the credit status of enterprises, making corporate information increasingly transparent, strengthening the government's pollution supervision of enterprises, reducing the cost of public participation in environmental supervision, which forces enterprises to increase green investment to cope with the external environment of big data. The internal reputation effect is mainly through the principal's rational expectations of the agent, to strengthen the manager's constraints on their own behaviour, thus playing a role in promoting corporate green investment. In conclusion, digital finance creates an innovative subversion of the traditional credit pricing model through credit transparency and informatisation, creates a transparent information environment, increases information accessibility, helps decision makers to prevent risks, reduces green investment avoidance due to information asymmetry, and at the same time, meets the intrinsic needs of corporate image building. Moreover, digital finance can reduce unfavourable market choices. The information provided by enterprises based on the platform is scrutinised by external stakeholders, thus gaining more external attention and resources, which also increases their willingness to make green investments. Enterprises will increase their green investments in order to build a good social reputation and achieve sustainable business development.

4. Indirect Impact Mechanisms of Digital Finance on Corporate Green Investments

Green investment, as a non-economic project with significant externalities, involves huge commitment costs, requires large sums of money, is difficult to generate an inflow of allocable direct economic benefits and may lead to a loss of economies of scale. Therefore, due to the high pre-investment costs, relatively slow profitability, high uncertainty and higher risk characteristics of green project inputs are more prominent, companies are less inclined to actively invest in environmental governance, especially for heavy polluters with rising and stringent pollution control costs and greater financial pressure. Digital finance greatly reduces the degree of market information asymmetry, which in turn reduces the cost and risk of green investment by enterprises. In addition, digital finance improves the efficiency of enterprise investment through efficient financial services, thus helping enterprises' green investment. The bank-led traditional financial system suffers from credit mismatch and inefficiency, which exacerbates the serious financing constraint environment for enterprises, thus hindering their green investment. Digital financial platforms, however, have greatly eased the financing constraints of highly polluting enterprises through low-threshold services, and have provided additional capital flows for corporate green investments with efficient financial services and lower loan risks, providing new opportunities to improve the corporate financing environment.

Through information technology and digital platforms, digital finance has freed itself from reliance on physical media, thereby expanding the scale of financial services and enhancing the precision, convenience and flexibility of financial services. By effectively screening enterprise subjects through big data, digital finance enables more financial resources to flow to green investment projects, greatly easing the financing constraints of enterprise green investment and providing efficient and low-cost financial support for enterprises. The development of digital finance extends the reach of traditional finance, reduces the credit threshold of enterprises, eases the financing constraints, optimises the stock structure of traditional finance, and then provides more financial support for enterprises to make green investments, and injects new kinetic energy into the green development of enterprises. Moreover, digital finance helps to absorb all types of social capital into the financial market, so that it can quickly provide funds when enterprises need funds for green investment. As a result, companies will not be less willing to invest green because of low internal capital reserves. The targeted nature of digital finance also helps to improve the efficiency of capital allocation by increasing the endogenous incentives for firms to invest green by increasing their cash flow. At the same time, digital finance ensures internal capital adequacy, and abundant cash flow can provide a stable source of funds for enterprises to increase green investment. Thus, by alleviating financing constraints, digital finance increases the likelihood of enterprises' access to market capital, prompting them to further increase their investments in order to enhance their green competitiveness.

5. Conclusion

First, it is necessary to promote the construction of digital financial infrastructure and its coordinated regional development, so as to provide a guarantee for enterprises to enhance their green investment. On the one hand, it is necessary to strengthen the construction of information technology infrastructure, actively promote the development of high-end core technologies such as big data, artificial intelligence, 5G, etc., so as to help improve the ability of financial services with the help of science and technology, innovate the mode of cooperation between finance and science and technology, and encourage the diversification of the financial industry, so as to better satisfy the demand for financial services and products of enterprises' green investment projects. On the other hand, it is necessary to narrow the regional differences in the development of digital finance, and endeavour to give full play to the latecomer advantages of economically less developed regions. Heterogeneity analysis shows that digital finance plays a stronger positive role in the central and western regions, while the level of digital finance development in the central and western regions is relatively low, so strengthening the digital finance infrastructure in the central and western regions can play a more important role in promoting their green economic development.

Secondly, the resource allocation function of the financial system should be strengthened through digital finance to optimise financial services for green projects. On the one hand, digital finance should be used to improve the distortion of factor allocation under the traditional financial model, and improve the efficiency of factor allocation and use. Through digital technology, digital finance can solve the problem of

information asymmetry and high financing costs, guide the flow of financial resources to environmentally friendly enterprises with innovation potential, and provide sufficient financial support for scientific and technological research and development. Moreover, with data as a production factor, digital finance can stimulate economic growth potential, give full play to the dividend of economies of scale, improve the efficiency of the use of various types of resource factors, achieve the effect of optimising the allocation of factors and improve the efficiency of factor use, and ultimately enhance the green total factor productivity. On the other hand, it is necessary to narrow the gap of market construction between regions. The previous analysis of heterogeneity shows that the role of digital finance in influencing green total factor productivity is stronger in regions with better market construction. Therefore, it is necessary to accelerate and improve the construction of a unified national market, and to give full play to the positive facilitating effect of digital finance on the optimal allocation of factors by strengthening the market-oriented construction of the energy market, the labour market, the capital market, the land market, and the commodity and service markets.

Thirdly, it is necessary to develop digital technological innovation and cultivate technological innovation talents, so as to provide a constant impetus for enterprises to enhance the level of green investment. Technological innovation is the fundamental driving force for the development of digital finance. Science and technology innovation and talent training have always played a very important role in the green development of enterprises. Therefore, increasing digital technological innovation and cultivating technological innovation talents is a necessary way for enterprises to achieve the goal of green development. Most of the enterprises in China are not mature enough to develop innovation, especially in the core technology is still facing the "neck" technical problems. Therefore, governments at all levels should continue to promote innovation and development-driven strategy, and advocate enterprises to carry out scientific and technological research and development, increase the training of high-tech talents, the introduction of efforts, and to improve the conversion rate of technological innovation, to avoid the waste of resources, improve the level of green investment, and promote the green development of enterprises. At the same time, the government should also introduce corresponding innovation incentive system and support policies, such as salary incentive mechanism, scientific and technological achievements transfer incentives, to create a favourable innovation atmosphere, promote digital technology innovation and talent

cultivation, in order to better promote the enterprise to the "green" and walk.

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