Influence of Digital Finance Development on the Investment and Financing of New Energy Enterprises

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Abstract. Amid the global climate and energy crisis, the development of the new energy industry is of paramount importance. However, persistent financing constraints remain a significant barrier to its growth. Digital finance offers new opportunities by fostering innovative financial models such as crowdfunding, digital securitization, and supply chain financing. These mechanisms not only expand financing channels for new energy enterprises but also enhance capital liquidity and investment efficiency, thereby contributing to the industry's sustainable development. This paper investigates the direct influence of digital finance on the investment and financing of new energy enterprises, analyzes its heterogeneous effects across different enterprise scales and regional contexts, and explores future research directions in this domain. These studies can provide a basis for understanding the functional mechanism of digital finance, optimizing the investment and financing decisions of new energy enterprises, solving financing difficulties and improving efficiency, so as to help new energy enterprises achieve sustainable development in a complex environment.

Keywords: Digital Finance, Investment and Financing, New Energy, Green Finance.

1 Introduction

In the context of global climate change and the energy security crisis, the new energy industry, as the core driving force of the green transformation of the global economy, is becoming more and more important. The International Energy Agency predicts that $1.2 trillion will be invested in renewable energy between 2023 and 2030 to achieve net zero emissions [1]. The realization of sustainable development is highly dependent on two key factors, new energy and digital finance [2]. With the help of big data, artificial intelligence, cutting-edge blockchain and other technologies, digital finance has risen strongly. Big data technology can deeply mine and analyze a large amount of user data, accurately assess users' credit status, and greatly reduce the risk of information asymmetry; Artificial intelligence technology can realize intelligent investment consulting and provide personalized financial services; blockchain technology ensures the security and transparency of transactions.

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However, the deep integration of digital finance and new energy is not smooth, and it still faces many challenges such as insufficient technological adaptation: on the one hand, the technical characteristics of new energy enterprises are different from the traditional financial service mode, and the digital financial technology is difficult to fully adapt; On the other hand, the application of digital finance in the field of new energy lacks a mature regulatory framework, and there are also certain risks and hidden dangers.

This study focuses on three core aspects: First, to discuss the direct impact of digital finance on the investment and financing of new energy enterprises; The second is to analyze the heterogeneous impact of digital finance on new energy investment and financing, and consider the differences of new energy enterprises in different sizes and different regions affected by digital finance; Third, clarify the future research direction of digital finance and new energy. This paper tries to establish a collaborative analysis framework of the "technology-system-market", which comprehensively reveals the internal logic of digital finance influence on the investment and financing of new energy enterprises and puts forward the future research direction on this basis.

This study is important in both theoretical and practical ways. On the theoretical level, this paper systematically sorts out the interaction mechanism between digital finance and new energy investment and financing, improves the credit evaluation theory and enriches the theoretical system of the integration of finance and industry; On a practical level, this research can help enterprises to break through financing bottlenecks and promote the integrated development of industry and finance. In addition, under the background of the "dual-carbon" goal and the national digital economy strategy, the discussion of this paper has practical reference value for promoting the high-quality development of China's new energy industry.

2 The Direct Impact of Digital Finance on the Investment and Financing of New Energy Enterprises

2.1 Provide a Mitigation Path for Financing Constraints

Optimization of Credit Evaluation under Technology Empowerment. In the traditional financial system, new energy enterprises have difficulties in credit evaluation due to the characteristics of this industry. This industry is capital-intensive, with fast technology iteration, large capital demand in the early stage of the project, long return cycle and high risk. Traditional assessments rely on limited financial data, and it is difficult to fully consider the actual risks and potential developmental [2]. With the help of advanced technology, digital finance innovates the credit evaluation of new energy enterprises. Big data can collect multidimensional data. In addition to the financial data, these data also include operational, market competition, industry dynamics, and network behavior data [3]. Through deep digging and analysis, financial institutions can establish an accurate and comprehensive evaluation model, accurately identify risks, and provide a reliable financing basis. AI plays a key role in credit evaluation. Machine learning algorithms can automatically learn data rules and dynamically adjust the

weight of evaluation indicators according to enterprise characteristics and industry trends[4]. For example, for solar photovoltaic research and development enterprises, more emphasis is placed on research and development investment, patented technology, team strength and other indicators, so as to make the evaluation more practical and reflect the real credit and potential.

Different empirical studies have differences in the selection of credit evaluation models and indicators. Several studies have used deep learning to handle unstructured data and mine credit risk, such as assessing corporate reputation [5] through textual sentiment analysis. Other studies focused on combining traditional and non-financial indicators to improve the accuracy of evaluation, such as constructing multidimensional evaluation models to determine the weight of indicators. In general, these studies all recognize that using digital financial technology to optimize credit evaluation can alleviate the information asymmetry between financial institutions and new energy enterprises, and lay a foundation for enterprises to obtain more financing opportunities.

Expansion of Diversified Financing Channels. The crowdfunding model breaks through with the traditional limits. New energy start-ups and early-stage companies often struggle to obtain support from traditional financial institutions due to their lack of collateral, operations and credit records. With the help of the Internet, crowdfunding enables companies to pass on their project concepts and prospects to the public and to attract individual and institutional investors to fund environmental identification and potential potential. For example, small distributed solar projects, using crowdfunding to attract surrounding residents, not only solve financial problems but also enhance the awareness of community participation [6].

Digital securitization has enhanced the liquidity of new energy assets. In view of the large asset investment scale, long return cycle and limited capital turnover rate of new energy enterprises, enterprises can realize future cash flow in advance by converting assets such as power generation facilities into tradable securities, and quickly obtain [7] of supply chain financing funds such as project development. In the new energy industry chain, the core enterprises have strong strength, but the upstream and downstream small and medium-sized enterprises have financing difficulties. With the help of digital finance, the core new energy vehicle manufacturers can provide accounts receivable financing for upstream suppliers, provide advance payment financing for downstream dealers, solve the capital bottleneck, enhance the stability and coordination of the supply chain, and enhance the competitiveness of the industry.

To sum up, financing modes such as digital securitization and supply chains are gradually emerging and provide diversified financing support for new energy enterprises at different stages of development with their unique advantages and innovative operation modes. This meets the diversified financing needs of enterprises and is of great significance to promoting the sustainable and healthy development of the new energy industry.

2.2 Dynamic Improvement of Financing Cost and Efficiency

Consensus and Distances on Transaction Cost Reduction. There is a certain consensus and disagreement on the impact of digital finance on the transaction costs of new energy enterprises.

It is agreed that digital finance can significantly reduce transaction costs with its technological advantages[1]. When traditional financial institutions serve new energy enterprises, due to their complex business process and information asymmetry, they spend a lot of manpower, material resources and time costs on customer search and contract signing. Using big data, artificial intelligence and other technologies, digital platforms can quickly obtain and analyze the multi-dimensional information of new energy enterprises, accurately match the supply and demand of funds, and greatly reduce operating costs. For example, through the real-time monitoring and analysis of enterprise production and operation data and market performance data, the platform can effectively evaluate enterprise risks and reduce the cost of due diligence.

The differences are mainly reflected in the cost of risk response between traditional institutions and digital platforms. Some views argue that the long-term risk management experience and customer trust base of traditional financial institutions give them certain advantages in dealing with complex risks: for instance, the treatment of systemic risk, credit risk and other aspects are relatively stable, and the cost of hidden risk may be lower [8]. Others argue that while digital platforms have achieved significant results in explicitly reducing costs, they may need to invest in additional costs to address data security risks and compliance risks in emerging enterprises, and the existence of these hidden costs may affect their overall cost-reduction effectiveness.

Quantitative Research Progress on Financing Efficiency Improvement. Under the background that digital finance helps new energy enterprises to expand diversified financing channels, quantitative research on improving financing efficiency is of great significance. Data envelope analysis (DEA) models, panel data analysis, and other methods provide a powerful tool for assessing and understanding this efficiency improvement.

DEA models are often used to evaluate the financing efficiency of new energy enterprises. By establishing a multi-input and multi-output index system, it can comprehensively consider the capital acquisition, financing cost, financing time and other investment factors, so as to determine the relative efficiency of new energy enterprises in the financing process. According to the analysis results of the DEA model, new energy enterprises of different sizes and stages of development can find their advantages and disadvantages in their financing activities, and then optimize their financing strategies[9].

Panel data analysis can study the financing efficiency of new energy enterprises from a more macro and dynamic perspective. It can integrate a large number of enterprise data in different time spans and geographical ranges, and make an in-depth analysis of the development level of digital finance, regional economic environment, policy support and other factors on the financing efficiency of new energy enterprises. For example, through panel data analysis, people can explore whether the popularization of

digital finance can significantly improve the financing efficiency of new energy enterprises in different regions, as well as the timeliness and intensity of policy subsidies[10].

3 Heterogeneous Impact of Digital Finance on New Energy Investment and Financing

3.1 Difference in Enterprise Size

In the context of digital finance, new energy enterprises of different sizes benefit to different degrees.

Large new energy enterprises have strong resource integration abilities and huge market influence and have advantages in traditional financing. Digital finance provides it with more diversified and more efficient financing options. For example, large enterprises are able to quickly raise large amounts of capital and optimize their capital structure with the help of digital securitization, fixed assets, or long-term usufruct[10]. At the same time, the use of big data analysis can make accurate investment decisions for them, so as to expand the business.

Small and medium-sized new energy enterprises are often at a disadvantage in traditional financing due to insufficient collateral, imperfect credit records and other factors. Digital finance brings new opportunities: the crowdfunding model enables it to raise funds for the general public, breaking through the traditional financing threshold, Some start-focused companies gain initial funding; the credit assessment system of digital finance integrates multidimensional data to provide credit to companies with innovative potential but poor financial data. However, small and medium-sized enterprises also face challenges when using digital finance. Due to their weak application ability of digital technology, they may have difficulties in understanding and operating complex digital financial products, which limits their benefits to some extent [10].

3.2 Regional Development Differences

Digital finance has different development levels in different regions, and the digital divide brings challenges to the financing equity of new energy enterprises. In developed digital finance regions, such as China's Yangtze River Delta, Pearl River Delta and California in the United States, perfect digital infrastructure and an active financial innovation atmosphere enable new energy enterprises to easily obtain rich digital financial resources. Local digital financial institutions are deeply integrated with the new energy industry and use big data risk control to provide precise financing services to reduce costs and improve efficiency. At the same time, the active investment atmosphere attracts a large number of venture capital and private equity investments, providing sufficient funds for the development of enterprises. In remote or economically underdeveloped areas where the development of digital finance lags behind, the digital divide makes it difficult for new energy enterprises to obtain financing [11]. They find it difficult to enjoy convenient digital financial services, have narrow financing

channels, and mainly rely on limited support from traditional financial institutions. Due to the lack of digital financial power, enterprises often face a shortage of funds for project investment and expansion, which limits the scale and speed of development. In addition, the digital divide will also aggravate the unbalanced development of new energy industries between regions, affect the fairness of financing, and put enterprises in backward regions at a greater disadvantage in the competition.

4 Future Research Direction

4.1 Direction of Theoretical Deepening

Construction of a Dynamic Model for the Coordinated Development of Digital Finance and New Energy Industry. Currently, the correlation studies between digital finance and the new energy industry are mostly static analyses or simple discussions of the causal relationship. In the future, a dynamic model needs to be built to deeply analyze the coordinated development mechanism of the two. The model should take into account the stage characteristics of digital financial development, the speed of technology iteration of the new energy industry and the change in the macroeconomic environment. For example, in the early stage of the development of digital finance, its support for the financing of new energy enterprises may be mainly reflected in broadening the channels; As digital finance matures, it will play a greater role in optimizing the capital structure of enterprises and promoting industrial integration. By constructing a model including these dynamic factors, it can more accurately predict the trend of the coordinated development of digital finance and new energy industry, and provide a scientific basis for policy formulation and enterprise strategic planning[12].

Theoretical Expansion of the Ternary Relationship of Technology-finance-energy. "Technology, finance and energy" are interwoven, and the current research is mostly limited to the bilateral relationship. In the future, the ternary relationship theory should be expanded from an interdisciplinary perspective. At the technical level, artificial intelligence, blockchain and other emerging technologies not only affect the digital financial service mode but also change the production and operation mode of the new energy industry; At the financial level, digital financial innovation provides financial support and risk diversification for the development of new energy industry; at the energy level, the development needs of new energy industry promotes digital finance and related technology innovation. Further, study the law of collaborative evolution of the three, explore how to promote the deep integration of digital finance and the new energy industry through technological innovation, and how to guide the sustainable development of the energy industry.

4.2 Practice and Breakthrough Path

Standardization and Internationalization of Digital Green Financial Instruments. With the global focus on climate change, digital green financial instruments have developed rapidly [13], but they face a lack of unified standards and a low degree of internationalization. In the future, it is necessary to promote the standardization of

digital green financial instruments, clarify the definition, classification, trading rules, risk measures and other standards of carbon financial derivatives, and improve market transparency and liquidity. At the same time, the people should strengthen international cooperation, promote mutual recognition and trading of digital green financial instruments on a global scale, and build a unified international carbon financial market. For example, formulate globally unified carbon emission accounting standards to make carbon financial derivatives comparable in different countries and regions comparable, promote the development of cross-border carbon financial transactions, and provide a broader source of funds and risk hedging means for the development of new energy industry [14].

Pilot Design of the Regulatory Sandbox in the New Energy Investment and Financing Scenario. As an innovative regulatory mechanism, the regulatory sandbox has the potential to balance financial innovation and risk prevention. In the new energy investment and financing scenario, the regulatory sandbox pilot design can be carried out.On the one hand, the pilot access standards should be clarified, and digital financial institutions and new energy enterprises with innovative and development potential should be screened to participate in the pilot and allowed to carry out innovative investment and financing businesses within a limited scope, such as new digital financing models and green financial product innovation. On the other hand, a dynamic monitoring and evaluation mechanism should be established to monitor the risk status and innovation effects of pilot projects in real time, and timely adjust regulatory policies and pilot rules according to the monitoring results. Through the regulatory sandbox pilot, it can not only encourage the innovation of digital finance in the field of new energy investment and financing, but also effectively prevent potential risks, and create a good regulatory environment for the healthy development of the new energy industry.

5 Conclusion

Digital finance leverages new technologies to provide diversified financing modes, broaden funding channels, optimizing credit evaluation, and improve financing efficiency for the new energy industry. This study finds that digital finance plays a significant role in enhancing the accessibility and affordability of financing for new energy enterprises, particularly for small and medium-sized firms that traditionally face difficulties in securing funds. Moreover, regional differences in digital financial infrastructure affect the extent to which these benefits can be realized, highlighting the need for tailored policy measures. However, there are challenges such as technology adaptation and balanced development in the integration. In the future, further theoretical research is needed to explore the long-term impacts of digital finance on corporate performance, innovation capacity, and sustainable growth in the energy sector. Additionally, strengthening policy supervision and regulatory frameworks is crucial to mitigating risks associated with digital finance while maximizing its benefits. Collaborative efforts among governments, financial institutions, and enterprises should focus on fostering a more integrated digital financial ecosystem, accelerating energy transformation, and supporting the transition towards a greener economy.

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