Journal of Applied Economics and Policy Studies Vol.18 Issue 6 EWA Publishing
Available Online: 5 August 2025 DOI: 10.54254/2977-5701/2025.25813

Leveraging fintech for green credit with innovations, effectiveness and strategic path

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Abstract. This paper focuses on the field of green credit business, offering a comprehensive review of the actual use and performance of innovative data applications, while also analyzing the latest industry developments through academic literature. As China transitions toward highquality development and aims to achieve its “dual carbon” goals, financial institutions have taken the lead in launching green financial instruments, among which green credit plays a critical role. However, it also faces many challenges. In recent years, the rapid development of fintech has been widely applied in the financial sector. The synergy between fintech and green finance is a key driver for green, lowcarbon, and circular development. The overarching strategy for fintech to promote green credit innovation is policydriven, with commercial banks as the main actors, supported by fintech to assist enterprises in emission reduction and green transformation.This paper presents practical examples of how technologies such as big data, artificial intelligence (AI), and blockchain are applied in green credit, highlighting how innovative data drives the development of green credit. It also reviews relevant academic literature and provides a critical reflection on the innovative use of data in green credit, offering insights for future development in this field.

Keywords: green credit, innovative data applications, industry trends

1. Introduction

The world now focuses deeply on climate change and actively looks for ways to develop sustainably making green finance clearly a central force and main direction in finance. Human activities cause climate irregularities that present extreme unprecedented challenges to ecosystems and socio-economic structures with frequent severe weather events seriously threatening the basic conditions for human life. In this situation developing green finance fits current trends and stands as a necessary choice for humanity’s future. Green credit a key part of green finance systems plays an irreplaceable important role. It works as a link tightly connecting financial resources to green industries and directing funds to flow accurately and smoothly into them [1]. These green industries include areas like renewable energy development resource recycling and ecological protection serving as main drivers to push economic green transformation. Green credit support lets these industries get enough capital speeding up technological innovation and industrial improvement to move the entire economic system toward green low-carbon sustainable development. In renewable energy for example green credit has helped build many wind and solar projects raising the share of these clean energies in the energy mix cutting reliance on traditional fossil fuels and lowering carbon releases.

Rapid progress in information technology has led to widespread use of innovative data tools like big data artificial intelligence and blockchain in green credit operations. These advanced technologies offer new ways to solve many tough problems in green credit development. Before green credit faced issues such as uneven information hard risk evaluation and high regulatory expenses. Big data with its strong ability to collect and analyze information can bring together various types of data letting financial groups fully understand companies business situations and environmental actions thus solving information gaps effectively. Artificial intelligence can make credit approval automatic and smart greatly increasing efficiency while using machine learning to keep improving risk evaluation models and boost risk management. Blockchain’s features of being decentralized unchangeable and traceable make green credit information more transparent and trustworthy reduce transaction costs and help with supervision.

Using these innovative data technologies has deeply changed traditional green credit operation methods and achieved notable results in practice. In real terms green credit keeps growing quality keeps getting better and more green projects are succeeding. This has pushed green industries forward and given financial groups new business growth and development chances [1]. Closely examining how innovative data technologies are used in green credit and their actual effects matters greatly for keeping green

credit development innovative and achieving joint progress between finance and the environment. It helps summarize experiences find problems improve how these technologies are used in green credit make green credit work better in economic green transformation and reach a win-win for economic growth and environmental protection.

2. Review of innovative data applications in green credit business

2.1. Application and performance of big data in green credit

Big data tools handle massive data and analyze deeply bringing major changes to green credit work in today's digital world and becoming key to its efficient accurate growth.

When picking clients financial groups use big data to gather many kinds of company information. Financial numbers show a company's financial strength and ability to pay back debts looking at balance sheets income reports and cash flow statements tells about its profit ability debt payment and cash flow [2]. Environmental data is key to checking if a company meets green credit rules big data collects details on pollution output energy use and how environmental equipment works to judge a company's environmental compliance and green development level. Industry data gives a broad view of a company's place and growth in its field different industries have different green development needs and potentials analyzing this data helps choose good industries and top companies. Studying these different data sets closely lets financial groups find companies with real green development potential that meet green credit standards reducing "greenwashing" risks from the start. One bank using big data in green credit work found a manufacturing company that seemed to meet environmental standards but used more energy than others and had environmental violation records the bank then avoided giving it green credit keeping funds safe and ensuring the capital stays green. Data shows after using big data to pick clients this bank had 30% fewer "greenwashing" problems making its green credit work better.

Green credit risks come from a company's business situation market changes and new environmental policies. Big data tools track a company's business and environmental risks in real time collecting production data to know business status market data to judge market risks and new environmental policies to assess risks [2]. Financial groups use advanced risk assessment systems with data from many sources to assess green credit risks in real time accurately and dynamically. One financial group used a machine learning risk assessment system taking company financial environmental production market and policy data as input improving assessment accuracy through model training and learning to warn quickly when indicators go wrong. When it found a company might not pay back due to environmental risks the financial group changed credit limits or asked for more collateral to reduce risk. Official data shows green credit projects using big data for risk assessment have 5 percentage points lower bad loan rates than traditional methods. In one green credit project a company faced business and environmental pressures from lower market demand falling prices and stricter environmental rules for production the big data system noticed this early the financial group changed the credit limit and asked for more collateral keeping green credit funds safe. Big data tools matter much in picking clients and assessing risks in green credit work supporting steady business growth helping green credit guide money to green industries better and pushing economic green transformation.

2.2. Application and performance of AI in green credit

Artificial intelligence (AI) technology, with its remarkable capabilities in data processing and pattern recognition, has significantly elevated the intelligence level of green credit businesses, demonstrating powerful efficacy particularly in the two core segments: intelligent approval and risk early warning.

In the realm of intelligent approval, AI models have profoundly revolutionized traditional manual approval processes, which were characterized by inefficiencies, strong subjectivity, and a propensity for oversight. By leveraging advanced algorithms and robust computational power, AI models can rapidly and efficiently process vast volumes of credit application materials. These models adhere to predefined green credit standards, conducting automated and precise reviews and approvals of applicant companies. This involves assessing environmental compliance, the feasibility of green projects, anticipated environmental benefits, and a scientific and rigorous risk assessment that includes corporate financial analysis, industry prospect forecasting, and market fluctuation impact assessments. This novel approval paradigm has led to substantial efficiency gains. For instance, a fintech company's meticulously developed AI green credit approval system has exhibited astonishing efficiency in practice, capable of completing a company's initial review within a mere 5 minutes. In stark contrast, traditional manual approval necessitates human review of each document, repeated comparison against standards, and extensive evaluation discussions, often taking 3 to 5 days [3]. We can quantify this improvement in terms of the approval efficiency multiple, calculated by the formula:

$$Approval\ Efficiency\ Multiple = Average\ Time\ for\ AI\ Intelligent\ Approval / Average\ Time\ for\ Traditional\ Manual\ Approval \quad (1)$$

According to Formula (1), the approval efficiency multiple is calculated to be 0.0007, indicating that AI approval is significantly more efficient than traditional manual approval. Regarding risk early warning, green credit risks originate from

complex and dynamic sources, including poor internal corporate governance, significant market environment fluctuations, and agile adjustments in environmental policies. The AI system, through continuous real-time analysis of massive datasets, acts as a vigilant guardian, capable of sensitively and rapidly capturing potential risk signals. When an enterprise exhibits environmental non-compliance, such as excessive emissions or violations of environmental laws and policies, or when financial indicators deteriorate—for instance, a sharp increase in debt-to-asset ratios, heightened cash flow interruption risks, or substantial declines in profit margins—the AI system reacts swiftly and issues immediate warnings. This early warning provides financial institutions with invaluable time to implement timely countermeasures. A certain bank's self-developed and continuously optimized AI risk early warning system successfully identified in advance the risk of a green energy company's declining market competitiveness due to slow technological updates. Upon detecting this risk, the bank promptly organized experts to re-evaluate the company's credit status and adjusted its credit strategies, such as moderately reducing credit limits, increasing loan rates, or requiring additional collateral, thereby effectively averting potential major losses. Unofficial statistics indicate that after adopting the AI risk early warning system, the bank avoided approximately 20% of potential significant credit risks. We can estimate the economic benefits through the amount of loss avoided, calculated using the formula:

$$Amount\ of\ Loss\ Avoided = Total\ Potential\ Risk\ Exposure \times AI\ Risk\ Avoidance\ Ratio \quad (2)$$

According to Formula (2), assuming the bank faced a total potential credit risk exposure of 100 million RMB within a certain period, the AI system theoretically enabled the avoidance of 100 million RMB×20%=20 million RMB in potential losses. This outcome lays a solid foundation for the stable development of green credit business and the health of asset quality. The robust advantages and remarkable achievements of AI technology in intelligent approval and risk early warning for green credit are profoundly transforming the operational models of green credit, injecting continuous momentum into the sustainable development of green finance [4].

2.3. Application and performance of blockchain in green credit

Blockchain technology has unique features including decentralization immutability and strong traceability bringing unprecedented transparency and high reliability to green credit business. Green asset registration via blockchain allows precise recording of detailed related information ensuring the authenticity and uniqueness of asset data thus fundamentally preventing duplicate asset pledges and fraudulent transactions. Tracking green credit fund flows through blockchain enables real-time end-to-end monitoring of every fund transaction ensuring green credit funds are genuinely and accurately used for green projects. A green supply chain finance project fully utilizing blockchain technology successfully achieved clear and complete recording of fund flows throughout the entire process from raw material procurement to product sales powerfully ensuring rational and effective use of green credit funds within the supply chain.

Blockchain technology can effectively promote interconnectedness in the green credit market different financial institutions can securely share green credit information through blockchain break long-standing information silos significantly reduce information asymmetry and comprehensively improve market operational efficiency [4].

3. Literature review on innovative data use in green credit

In recent years, as data-driven innovation in green credit services has expanded rapidly academia has carried out extensive and in-depth studies on this area. On the use of big data technology scholars generally agree that big data can effectively address information gaps in green credit and greatly boost the accuracy of risk evaluation. Risk assessment models powered by big data can significantly improve the precision of green credit risk analysis and cut down credit risks effectively. Research findings show big data’s ability to integrate multi-dimensional data offers a more complete and precise foundation for risk evaluation letting financial institutions spot potential risks with greater accuracy.

In studies on artificial intelligence applications AI can automate and smarten green credit approval procedures raising approval efficiency substantially. It also uses machine learning algorithms to constantly refine risk assessment models thereby enhancing risk management capabilities on an ongoing basis. Some scholars however note that AI technology’s use in green credit faces practical hurdles like data quality issues and algorithmic bias requiring stronger data governance and algorithm oversight [5]. They argue that poor-quality data may lead AI models to misjudge situations and algorithmic bias can undermine fairness and accuracy making it necessary to establish strict data quality standards and algorithm review systems.

Concerning blockchain technology’s application in green credit blockchain can greatly enhance the transparency and reliability of green credit information cut transaction costs effectively and strongly drive the healthy development of the green finance market. Some research however has sharply pointed out that blockchain technology’s use in green credit encounters problems such as inconsistent technical standards and inadequate legal frameworks demanding stepped-up efforts in formulating industry standards and legal supervision. For example the absence of unified technical standards results in poor compatibility

between different blockchain platforms limiting their widespread use in green credit; furthermore inadequate legal frameworks make it hard to clarify responsibilities and resolve issues when disputes occur.

4. Critical review and reflection

From a comprehensive perspective encompassing practical applications and research literature, innovative data technologies have demonstrated immense development potential and significant positive effects in green credit operations. The application of technologies such as big data, artificial intelligence, and blockchain has comprehensively enhanced the efficiency of green credit business, substantially reduced risk levels, and greatly increased business transparency. However, in the midst of this vigorous development, some urgent problems and severe challenges are inevitably encountered.

4.1. Challenges

The application of innovative data technologies is highly reliant on high-quality data; however, current green credit data generally suffer from prominent issues such as inconsistent standards, missing data, and untimely updates, which severely undermine the practical effectiveness of technological applications. Differences in the definitions and statistical calibers of green credit data among different institutions make data integration and comparison difficult; missing data lead to biased analytical results, failing to accurately reflect the actual situation of enterprises; and untimely data updates may cause delayed decision-making, resulting in missed optimal opportunities. Meanwhile, data security and privacy protection are critical issues that cannot be ignored. Financial institutions face risks of data leakage and misuse during data collection, storage, and utilization [5]. A data security incident, if occurring, would seriously damage customers' rights and interests as well as the reputation of financial institutions.

The application of technologies such as big data, artificial intelligence, and blockchain requires substantial capital investment in technology R&D, equipment procurement, and system maintenance, as well as interdisciplinary professionals proficient in both finance and technology. For some small and medium-sized financial institutions, the high cost of technology application and talent shortages have become significant barriers to promoting innovative data applications. Small and medium-sized financial institutions often have limited financial strength, making it difficult to undertake large-scale technological investments. In the talent market, the shortage of interdisciplinary talents increases recruitment difficulties, leaving small and medium-sized financial institutions far behind large ones in technology application.

With the widespread adoption of innovative data technologies in green credit, the inadequacy of relevant laws, regulations, and supervisory policies has become increasingly prominent, restricting the further development and application of these technologies. Currently, laws and regulations related to big data privacy protection, AI algorithm supervision, and the legal status of blockchain smart contracts are incomplete, and supervisory policies also show a certain lag, struggling to adapt to the rapidly evolving demands of technological innovation. This exposes financial institutions to legal risks and compliance uncertainties when applying innovative data technologies, discouraging them from bold innovation and business expansion.

4.2. Recommendations

First and foremost, establishing unified and standardized green credit data standards, strengthening data quality management, and ensuring the accuracy, completeness, and timeliness of data are crucial. Financial institutions should enhance the development of internal data management systems, set up data quality monitoring mechanisms, and regularly clean and update data. At the same time, great emphasis must be placed on data security protection: advanced encryption technologies, access control tools, and data backup solutions should be adopted to reinforce security measures during data storage and transmission, preventing leaks and misuse. Additionally, employee training on data security awareness should be stepped up, and data operation practices standardized.

Equally vital is increasing investment in technological research and development while boosting talent cultivation. Financial institutions ought to raise R&D spending on innovative data technologies, actively explore technical solutions tailored to green credit operations, and lower the costs of technology application. Meanwhile, deepening collaboration with universities and research institutions and building an industry-academia-research-application collaborative innovation mechanism will help collectively tackle technical challenges. For talent development, a comprehensive plan should be crafted—through internal training, external studies, and talent recruitment—to cultivate a cohort of interdisciplinary professionals skilled in both financial services and advanced technologies. Furthermore, talent incentive systems can be established to improve compensation, thereby attracting and retaining top talent.

Another key step involves improving the legal framework and regulatory policy system. Government departments should accelerate the formulation and refinement of laws and regulations governing the application of innovative data technologies, clarify provisions on data privacy protection, algorithm supervision, and the legal status of smart contracts, and provide clear legal grounds for financial institutions' innovative development. Simultaneously, regulatory authorities need to strengthen

oversight of innovative data technology applications in green credit, establish a robust regulatory system, innovate supervision methods, and use technical tools to enhance risk monitoring and assessment of technology applications—ensuring the healthy and compliant growth of these innovative data technologies. Moreover, international cooperation should be expanded to draw on global best practices, advancing the internationalization of innovative data applications in China's green credit sector.

While the application of innovative data technologies in green credit has yielded notable results, significant room for growth and improvement remains. By effectively addressing current issues and challenges, and continuously deepening the integration of innovative data technologies with green credit operations, a steady stream of momentum will be injected into the sustainable development of green credit—supporting China's economy in achieving green, high-quality growth. Looking ahead, innovative data applications in green credit are expected to deliver more substantial outcomes in technological innovation, application expansion, and risk management, offering Chinese wisdom and solutions to the global development of green finance.

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