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Research on Digital Inclusive Finance Empowering the Development of Liaoning's Marine Economy

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Abstract: This article focuses on how digital inclusive finance empowers the development of Liaoning's marine economy. The research shows that while digital inclusive finance in Liaoning Province has grown rapidly in recent years, it still faces shortcomings in usage depth and coverage breadth. At present, digital inclusive finance has a significant empowering effect on Liaoning's marine economy, but challenges remain, including insufficient coverage and limited application of infrastructure, imperfect data governance and risk control systems for the marine economy, and a mismatch between digital financial products and the needs of the marine industry. To address these issues, the article proposes optimized pathways for digital inclusive finance to support Liaoning's marine economy: improving digital financial infrastructure to enhance service accessibility and efficiency; strengthening marine economic data governance to build an intelligent risk control system; innovating digital financial products to better align with industrial demands.

Keywords: Digital inclusive finance; Marine economy; Liaoning economy

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1. Introduction

Nowadays, the marine economy has become a key driver for empowering the sustainable growth of China's economy. Liaoning Province, with its strategic location along the Bohai Sea and the Yellow Sea, boasts a marine functional zone of 41,300 square kilometers and 633 islands, endowed with abundant marine resources. It has achieved remarkable success in fisheries, marine equipment manufacturing, port operations, and other fields. In the process of marine economic development, the role of financial services has become increasingly vital. Marine economic industries are often characterized by large investment scales, long payback periods, and high risks, which pose challenges to traditional financial service models.

Leveraging cutting-edge technologies such as big data, cloud computing, and the Internet, digital inclusive finance provides innovative solutions to address the financial challenges in the development of the marine economy. Its advantages in transcending geographical and temporal constraints, reducing service costs, and enhancing financial service accessibility, demonstrate tremendous application value in the marine economy sector.

At present, scholars have employed diverse methodologies to investigate how digital inclusive finance empowers the marine economy. Shuhong Wang demonstrated the enhancing effect of financial development on marine industrial productivity. Jian Lingxiang and others revealed the positive impact of the digital economy on the development of China's marine industry through random forest algorithms and partial effect models.

This article analyzes the current status and challenges of digital inclusive finance inempowering Liaoning's marine economy while exploring optimization pathways. It enriches the academic achievements in the fields of digital inclusive finance and the marine economy, and also provides a reference for marine industry practitioners to utilize digital financial resources.[1]

2. Mechanism Analysis of Digital Inclusive Finance Empowering the Marine Economy

2.1 Broaden Financing Channels and Improve Risk Sharing Mechanisms

Under traditional financial models, projects such as deep-sea aquaculture facilities construction often struggle to secure financing due to information asymmetry. Digital inclusive finance breaks through conventional limitations by leveraging technologies such as big data and the Internet, and reaches a broader range of entities through online platforms. This enables some small and medium-sizedmarine enterprises and individual aquaculturists who previously failed to meet standard requirements to obtain financing opportunities. Moreover, beyond traditional bank funding, digital inclusive financial platforms have also attracted internet financial institutions, private capital and others to participate in marine investment.

To address risks confronting the marine economy, including natural disasters and operational accidents, digital inclusive finance enhances the risk resilience by establishing multi-stakeholder mechanisms. Insurance institutions can develop diversified marine insurance products; while inclusive finance platforms may integrate upstream and downstream industry chain data to establish supply chain finance models. Under such frameworks, core enterprises collaborate with financial institutions to provide financing services for small and medium - sized enterprises across the supply chain, enabling rational risk distribution within the industrial ecosystem.[2]

2.2 Reduce Costsin Service Provision

Marine economic activities involve extensive manual field surveys. Taking ocean - going fishing enterprises as an example, financial institutions need to conduct on - site verification of vessel assets and fishing operations. Relying on Internet technology, digital inclusive finance enables online financial service delivery, providing cost-efficient solutions for marine economy participants while enhancing operational efficiency.

2.3 Facilitate Industrial Transition toward Advanced Production Modes

The marine economy is at a critical juncture of of transformation and upgrading, requiring technological innovation and business model diversification. Financial institutions can launch digital inclusive financial products such as intellectual property pledge loans and scientific and technological achievement transformation loans to foster emerging industries such as marine biopharmaceuticals and ocean renewable energy. Furthermore, digital inclusive finance also supports the development of new formats including marine tourism and marine cultural creativity, providing an innovative impetus for industrial structure advancement in the marine economy.[3]

3. Development Status of Digital Inclusive Finance and Marine Economy in Liaoning Province

According to the "Peking University Digital Inclusive Finance Index" compiled by the Institute of Digital Finance at Peking University, Liaoning Province has experienced rapid development in digital inclusive finance over the past decade, with the aggregate index surging by 653.73%. A deeper analysis reveals that the growth rate of digitalization level significantly outpaced the expansion in service coverage breadth, usage depth, and the overall index **Table 1**.

Table 1 Digital Inclusive Finance Index of Liaoning Province(2011-2020)

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Overall Index	43.29	103.53	160.07	187.61	226.4	231.41	267.18	290.95	311.01	326.29
Coverae breadth	44.96	89.01	126.67	175.49	194.17	207.74	239.87	271.81	292.44	307.11
Usage depth	44.64	120.36	181.54	162.89	178.41	220.06	291.27	279.48	302.52	328.12
Digitali -zation level	35.33	120.91	231.33	272.53	420.06	330.21	313.57	375.01	387.77	386.33

A comparative analysis between Liaoning and China's leading marine economies—Guangdong, Shandong, and Shanghai—reveals that the most pressing enhancement requirement lies in usage depth, followed by coverage breadth **Table 2**.

Table 2 Digital Inclusive Finance Index of Liaoning Province(2020)

Administrative region	Liaoning	Guangdong	Shandong	Shanghai
Overall Index	326.29	379.53	347.81	431.93
Coverage breadth	307.11	356.94	331.66	395.20
Usage depth	328.12	404.35	343.49	488.68
Digitalization level	386.33	409.06	409.00	450.08

In 2023, Liaoning's marine industry achieved a total output value of 490.52 billion yuan, marking a 5.4% year-on-year growth.The six coastal cities, leveraging their own endowment advantages, have injected strong momentum into marine economic development. The Dalian Central Sub-branch of the People's Bank of China has introduced pivotal policies including: "Guidelines on Financial Support for High-Quality Development of the Marine Economy" and the "Implementation Plan for Building Changhai County as a Pilot Zone for Inclusive Finance Ecosystem " . These measures aim to guide financial institutions in enhancing the supply of inclusive financial products.[4]

China Construction Bank Dalian Branch has launched the "Floating Raft Aquaculture" inclusive credit loan tailored for Changhai County's industrial characteristics. By accepting sea area use rights as collateral, this product effectively resolves financing difficulties faced by oyster farmers lacking traditional collateral. Up to now, the "Floating Raft Aquaculture Loan" has been extended to 7 households with a total issuanceof 2.2 million yuan. Upon maturation of the Changhai County pilot, the product will be rolled out across the entire Dalian city. Following the launch of "Aquaculture e-Loan - Sea Cucumber Loan", Industrial and Commercial Bank of China Dalian Branch strategically expanded services in the second quarter of 2025 to include signature

marine farming species such as oysters and scallops in Changhai County, disbursing more than 36 million yuan in loans to 30 local aquaculture operators.

Since the beginning of this year, Postal Savings Bank of China Huludao Branch has disbursed cumulative loans exceeding 26 million yuan to 11 fishing households. At the Zhongshun Jellyfish Trading Market in Gaizhou, Yingkou, Postal Savings Bank of China Yingkou Branch facilitates merchant financing through its specialized "Jellyfish Cash Flow Loan" and "Jellyfish Industry Chain Loan" products. In Donggang, Dandong, Postal Savings Bank of China provide tailored services for the "variegated clam" industry, including door to door financial services and bulk credit approvals. For Dalian's sea cucumber industry, Postal Savings Bank of China has launched salted sea cucumber pledge loans, with core enterprises acting as supervisors and disposers to conduct joint supervision with the bank. A third-party evaluation agency is introduced for valuation, and loans are granted at 50% of the valuation price.

In addition, digital inclusive finance has also played a pivotal role in the financing of marine economic enterprises. Since 2024, 27 marine and port enterprises in Liaoning Province, including port-related listed companies, have raised over 30 billion yuan through bond issuances.[5]

4. Challenges in Digital Finance's Empowerment of Liaoning's Marine Economy Development

Liaoning Province still faces multiple challenges in leveraging digital inclusive finance to empower the development of the marine economy.

4.1 Inadequate Coverage and Restricted Application of Digital Financial Infrastructure

Marine economic entities are predominantly distributed across coastal counties and islands such as Changhai County and Zhangzi Island, where remote locations and unstable fishing village network coverage impair digital financial service delivery. At the same time, Digital literacy disparities among marine economic actors persist, with older fishermen demonstrating particularly low adoption rates for online identity verification and e-contract signing processes. This creates enduring barriers to digital financial product accessibility. Inadequate comprehension of online credit products' eligibility criteria and repayment terms constrains the outreachefficiency of digital financial services.

4.2 Inadequate Data Governance and Underdeveloped Risk Control Systems for the Marine Economy

Liaoning's marine industries involves multiple fields such as fishery, ports, shipbuilding, and meteorology. Relevant data are scattered in different departments such as agriculture, maritime affairs, and meteorology, with inconsistent data standards and an imperfect sharing mechanism. There is no electronic ledger for data such as fishermen's catch volumes, aquaculture areas, and seafood transaction records, preventing financial institutions from validating big data models. Meanwhile, existing risk control models demonstrate inadequate capacity to quantify marine economy exposures, particularly ecological-environmental hazards and operational safety threats. Financial institutions still predominantly rely on manual due diligence when extending credit to marine industries, with inadequate utilization of critical oceanographic data such as sea surface temperature anomalies and current patterns, resulting in suboptimal risk assessment model accuracy.

4.3 Poor Alignment between Digital Financial Products and Marine Industry Needs

The fishing industry's seasonal characteristics—such as spring seedling cultivation and autumn fishing—require substantial short-term financing at critical junctures. However, most existing financial products enforce fixed repayment schedules, failing to accommodate its "lump-sum expenditure, staggered revenue" cash flow pattern. Industries such as marine equipment manufacturing and marine biomedicine are technology-intensive sectors characterized by long R&D cycles and heavy capital investment. Their core assets mainly consist of specialized equipment or intellectual property rights, while traditional digital credit products still primarily rely on fixed asset mortgages, and the evaluation system for intangible assets remains underdeveloped. In addition, marine tourism is highly susceptible to weather conditions, policy changes, and other external factors,resulting in elevated operational risks. However, traditional digital credit products still primarily rely on fixed-asset mortgages, and the evaluation system for intangible assets remains underdeveloped.

5. Countermeasures for Digital Finance to Empower the Marine Economy Development in Liaoning Province

5.1 OptimizeDigital Financial Infrastructure and Enhance Service Accessibility Efficiency

Increase investment in network coverage for coastal counties and island areas, extending 5G base stations to fishing villages and fishing ports to improve maritime signal quality. At the same time, leverage the digital rural development initiative to deploy self-service financial service terminals at fishery cooperatives, offering digital services such as loan applications and insurance enrollment.Financial institutions should organize "Digital Finance into Fishing Villages" campaigns, using case studies and live demonstrations to educate fishermen on utilizing digital financial services. Illustrated user guides should be distributed, and training sessions should be conducted during fishing off-seasons when vessels are docked. In addition, financial institutions may develop marine-adapted streamlined digital finance products, such as voice-interactiveloanapplication interfaces and offline contract signing capabilities to significantly improve the practical accessibility of digital financial services.

5.2 Enhance Data Governance for Marine Economy and Establish a Risk Control Framework

Establish a governance system centered on "data integration - model optimization - risk early warning". Establish a government-led"Marine Economic Data Sharing Platform" to break down data barriers between different departments and unify data standards. At the same time, promote the digitization of fishermen's production data, support fishery cooperatives in establishing electronic record systems to achieve traceable operational information.

Enhance quantitative assessment of marine-specific risks. Financial institutions should collaborate with marine research institutes to develop risk evaluation models, incorporating data such as seawater temperature variations, ocean current patterns, port throughput volumes, and international seafood prices into model parameters. In addition, for critical data including fishermen's credit records and vessel mortgage information, authenticity must be rigorously verified. For high-risk credit operations, a dual -layer risk control mechanism combining automated data verification with manual review shall be implemented..

5.3 Innovate Digital Financial Products and Enhance Industrial Adaptability

In response to the seasonal characteristics of marine fishery, financial institutions may develop flexible credit products featuring " quarterly interest payments with principal repayment during the harvest period"; for technology-intensive enterprises such as marine equipment manufacturing and biomedicine, optimize intangible asset valuation systems, incorporate indicators such as patent conversion rate and technology maturity into the risk control dimension, and promote intellectual property pledge financing. To strengthen risk protection, it is essential to expand the coverage and customization of insurance, encourage insurance companies to develop specialized coverage products that integrate storm classification data with automated claims mechanisms to enable rapid payouts. For marine tourism operators, introduce business interruption insurance to cover losses from unforeseen risks.

6. Conclusion

Digital inclusive finance has served as a crucial enabler for Liaoning's marine economy development. Through mechanisms such as broadening financing channels, reducing transaction costs, and promoting industrial innovation, it has achieved remarkable results in helping the transformation and upgrading of the marine industry. However, it still faces constraints such as inadequate digital infrastructure, data governance gaps and product-market mismatch. By enhancing digital infrastructure, optimizing data sharing mechanisms, and innovating customized financial products, the enabling effect of Liaoning's digital inclusive finance on the marine economy can be further released. In the future, Liaoning Province should capitalize on emerging opportunities to optimize the financial ecology continuously, enhance government-industry-university-research collaboration to propel the Liaoning's marine economy to new heights.

Disclosure statement

The author declares no conflict of interest.

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