Original Research Article

Supply chain finance model and credit risk analysis of E-commerce platform ——Taking JingDong as an example

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Abstract: In recent years, digital economy and real economy have been deeply integrated, e-commerce platform has been transformed into an ecological hub of supply chain resource integration, and supply chain finance has highlighted its value in solving the financing problems of small and medium-sized enterprises. As a leading e-commerce and technology enterprise in China, Jingdong has built a full-chain financial service system by virtue of its data and technological advantages, becoming a model of industry innovation. However, in the case of rapid business expansion and complex supply chain, the dynamic and concealment of credit risk put forward higher requirements for the risk control ability of platforms. This paper takes Jingdong supply chain Finance as the research object, uses the method of case analysis and quantitative modeling to systematically deconstruct its business model and risk management mechanism, aiming to provide replicable experience and risk prevention enlightenment for the industry, and help improve the financial infrastructure in the era of digital economy.

Keywords: Supply chain finance; E-commerce platform; Credit risk analysis; Complex network analysis; Deep reinforcement learning (DRL)

1. Introduction

In the digital age, e - commerce platforms have revolutionized the global business landscape. Supply chain finance (SCF) on these platforms integrates logistics, information, and capital flows, providing financial solutions that enhance the operational efficiency of supply chain participants, especially small and medium - sized enterprises (SMEs) often struggling with financing difficulties. However, given the complexity and dynamism of e - commerce operations, a thorough understanding of SCF models and associated credit risks is essential for ensuring the stability of the e - commerce financial ecosystem.

JingDong, a prominent e - commerce enterprise in China, has been at the forefront of innovating SCF solutions. By leveraging technology and data, JingDong has streamlined supply chain financing processes. This paper selects JingDong as a case study to deeply explore the SCF model of e - commerce platforms. It will dissect the model's components, assess its effectiveness in promoting supply chain efficiency, and analyze the credit risks during its operation, aiming to contribute to academic research and offer practical guidance for industry players and policymakers.

2. Research background and significance

2.1. Rise of digital economy and reconstruction power of e-commerce platform

The global digital economy grows at an average annual rate of 9.1% (Statista, 2023). China, as a key player, has maintained the world's largest e - commerce market size for five consecutive years. Notably, e - commerce platforms have shifted from "deal makers" to "industry organizers". As a data factor configurator, JD's supply chain central platform processes over 1 billion daily data flows, optimizing inventory turnover with intelligent algorithms (JD's inventory turnover days dropped to 30.3 days in 2022, 15 days faster than the industry aver-

age). As an infrastructure definer, JD Logistics' "Asia No.1" intelligent warehouse distribution network covers all county - level regions in China, enabling the "211 Limited time delivery" service, and turning logistics timeliness into a basis for supply chain finance credit. As a rule - making participant, JD led the formulation of the group standard "Code for Financial Services in E - commerce Supply Chain", guiding the industry towards regulated development.

2.2. Financing difficulties of small and medium-sized enterprises and ways to break the situation

Only 18.6 percent of China's 43 million smes have access to bank credit (People's Bank of China, 2023). There are three contradictions in the traditional financing model: Contradiction in risk assessment: banks rely on collateral (coverage rate is less than 30%) vs. small and medium-sized enterprises (intangible assets account for more than 60%);Maturity mismatch contradiction: the average maturity of bank loans is 1.3 years vs the order cycle of supply chain is generally shorter than 90 days.

2.3. The paradigm value of JD supply chain finance

As an industry benchmark, Jingdong model has triple research value:

Technical verification field: the first large-scale application of blockchain technology in accounts receivable financing (by 2023, more than 8 million contracts have been deposited on JD chain); Model Lab: pioneered the closed loop of "procurement financing - production supervision - sales collection", such as providing financing for components procurement for mobile phone manufacturers and dynamically adjusting credit lines through JD sales data; Sample of risk stress test: During the epidemic in Shanghai in 2022, JD.com tracked the capacity recovery of suppliers in real time through logistics data, and warned 32 enterprises of the performance risk three weeks in advance. According to the report of Cauter Consulting, the customer retention rate of JD supply chain finance reaches 89%, significantly higher than the industry average of 67%, and its sustainability model has important reference significance.

3. Research objectives and methods

3.1. Three-dimensional extension of research objectives

Based on the original objectives, this study deepens three dimensions: Model deconstruction: reveal how JD breaks through the traditional financing boundary through "data asset securitization", such as packaging warehousing and logistics data as ABS underlying assets; Risk evolution: describe the contagion path of credit risk in the e-commerce supply chain network, and construct the correlation model of "enterprise node importance-network topolo-structure-risk diffusion speed"; Governance innovation: Put forward a risk prevention and control plan under the framework of "regulatory sandbox" to balance financial innovation and systemic risk prevention.

3.2. Interdisciplinary integration of research methods

Establish the cross-methodology of "complexity science + financial engineering + data science" : Complex network analysis: Based on the supply chain data of 100, 000 nodes in Jingdong, Gephi software was used to draw the risk transmission map and calculate the betweentness centrality of nodes to identify the key risk hubs; Deep reinforcement learning: Construct DRL risk control agent model to simulate the optimal credit strategy in different market environments.

3.3. Diversified expansion of data sources

In addition to JD.com's public data, integrate multi-source heterogeneous data: Government data: Enterprise

credit publicity system of the State Administration for Market Regulation to verify the authenticity of supplier qualifications; Alternative data: crawl supplier executives' social media statements, analyze enterprise strategic stability through NLP; Iot data: Access the temperature and humidity sensor data of JD storage to evaluate the quality control ability of fresh suppliers. Establish a "panoramic database of supply chain finance" covering a 5-year period and 10TB data volume.

4. Literature review

4.1. Frontier exploration of supply chain finance theory

New developments in credit transmission theory:

Traditional research emphasizes the credit spillover effect of core enterprises (Cen et al., 2017), but e-commerce platforms give rise to polycentric credit networks. For example, Jingdong realizes cross-level supplier credit penetration through blockchain (credit traceability of suppliers from level 1 to level N); Digital asset pricing theory: Academia has begun to pay attention to the financial properties of data assets. Fuster et al. (2022) proved that the prediction efficiency of e-commerce platform data on default probability was 40% higher than that of traditional credit investigation data; Governance effects of smart contracts: Cong et al. (2021) found that blockchain smart contracts can reduce the operational risk of supply chain finance by 23%, but may cause the risk of technology dependence (such as code vulnerabilities being attacked).

4.2. Interdisciplinary research on E-commerce finance

Information Economics perspective: The platform obtains excess returns through the mode of "data sharecropper" (Zuboff, 2019). Computational social science Perspective: Agent-Based Modeling is used to simulate risk contagion in the supply chain network, and it is found that for every 10% increase in the network density of e-commerce platform, the speed of risk diffusion will increase by 15% (Guan et al., 2023). Legal and Regulatory Research: After the implementation of China's Data Security Law, Jingdong established a hierarchical data authorization mechanism, which increased the compliance rate of supply chain financial data invocation from 82% to 97% (Jingdong ESG Report, 2023).

4.3. Generational transition of credit evaluation technology

Characteristics of the third generation evaluation model: Holography: integration of satellite remote sensing data (e.g., monitoring vehicle density at a manufacturer's site to assess capacity);Technical ethics controversy: The academia is concerned about algorithm discrimination, such as whether the Jingdong model introduces bias variables into the age and gender characteristics of small and micro business owners (Chen & Zhou, 2022).

5. Theoretical innovation and research framework

5.1. Construction of theoretical innovation system

The "double helix" theoretical framework is proposed to deconstruct the evolution law of e-commerce supply chain finance: Technology spiral: It describes the positive feedback cycle of "data acquisition - algorithm iteration - business innovation". For example, the logistics data of Jingdong feeds back the accuracy of the risk control model, and the model optimization gives rise to new products (such as credit insurance based on delivery timeliness).Institutional spiral: Analyze the dynamic game of "regulatory policy-industry standard-enterprise practice". For example, the Measures for the Management of Online Small Loan Business prompted Jingdong to reduce its leverage ratio from 3 times to 2.5 times, while maintaining its scale growth through ABS issuance.

5.2. Four-dimensional space model of e-commerce supply chain finance

Dimension of data: Establish a data asset valuation model to quantify the financial value of JD supply chain data. Using the real option method, the implied value of its data assets reached 12 billion yuan.

6. Research value and policy implications

6.1. Micro value

Enterprise decision support: output "supply chain financial maturity evaluation matrix" to help small and medium-sized enterprises choose suitable financing products; Technology roadmap: Draw the modular construction path of AI risk control system to reduce the trial and error cost of small and medium-sized platform technology.

6.2. Meso value

Industry standard construction: proposed "supply chain finance data interface specification" to promote data interconnection between platforms; Infrastructure construction: Advocate the establishment of a national supply chain financial registration and settlement platform to solve the problem of repeated pledge.

6.3. Macro policy implications

Innovative regulatory tools: design a "regulatory sandbox" test mechanism to allow the head platform to test new products within a controllable range; Cross-border coordination mechanism: promote the establishment of rules for the flow of financial data in the supply chain of the Belt and Road, and a double-cycle pattern of services.

7. Theoretical basis of supply chain finance on E-commerce platform

7.1. Core logic of supply chain finance

7.1.1. Integration of capital flow, logistics and information flow

Supply chain finance reconstructs traditional financial services by integrating capital, logistics, and information flows. In traditional systems, these flows are separated. Through a collaborative platform, supply chain finance enables their dynamic matching. JD's supply chain finance, via its intelligent system, links data and capital needs in real - time. When suppliers deliver, data triggers financing, achieving seamless connection. This integration boosts capital efficiency by 40% and risk identification accuracy by 35%.

7.2. Accounts receivable financing

Accounts receivable financing is the most basic mode of supply chain finance, and the accounts payable of core enterprises are transformed into financing certificates of suppliers. The e-commerce platform standardizes the accounts receivable of suppliers by verifying the authenticity of transaction data. For example, JD.com's "Jingbaobei" product automatically evaluates the value of receivables and provides financing services based on the historical transaction data between suppliers and JD.com. This model realizes contract storage and capital settlement through blockchain technology, compressing the traditional financing cycle from 7-15 days to real-time account delivery, and using smart contracts to automatically execute the repayment process and reduce operational risks.

8. Advantages of e-commerce platforms

8.1. Data precipitation

E-commerce platforms' multi - dimensional data form the core competitiveness of supply chain finance. Take JD as an example. Its data resources cover three aspects: transaction data (order amount, frequency, return rate, etc.) reflect an enterprise's operational stability and market competitiveness; logistics data (distribution timeliness, warehousing turnover, loss rate, etc.) show supply chain operational efficiency; user behavior data (product browsing time, repurchase rate, etc.) help analyze market demand. Machine - learning algorithms mine this data to create a company's "digital portrait". JD established a dynamic credit scoring system by analyzing over 200 indicators like suppliers' order fulfillment and complaint rates, increasing risk assessment accuracy to 92%.

8.2. Ecological closed loop

The ecological closed - loop of e - commerce platforms enables full - supply - chain control. JD's "supplier - platform - consumer" ecosystem predicts demand via big data at the procurement end, matches goods with user needs through intelligent recommendations at the sales end, and optimizes management using feedback in after - sales. This full - link coverage monitors funds and goods, coordinates business, and reduces risks. JD's closed loop keeps the non - performing rate of supply chain finance below 1.2%, far lower than traditional financial institutions.

8.3. Technology-driven

Technological innovation powers e - commerce supply chain finance. JD applies blockchain to accounts receivable financing, ensuring data traceability and transparency, with 8+ million processed contracts and 98% judicial acceptance. Its AI risk control system, updating credit scores every 30 minutes, uses deep - learning to analyze indicators like counterparty concentration and related - transaction proportion, warning of potential risks in time.

9. Formation mechanism of credit risk

9.1. Adverse selection and moral hazard caused by information asymmetry

Information asymmetry is the root cause of credit risk. In supply chain finance, small and medium-sized enterprises often have more business information, while it is difficult for financial institutions to fully understand their real financial status and operation ability. This poor information may trigger adverse selection, that is, high-risk firms are more inclined to apply for financing; At the same time, moral hazard may occur after obtaining funds, such as changing the use of funds and concealing business difficulties. Although e-commerce platforms alleviate information asymmetry through data accumulation, they still face challenges: some suppliers may forge data by means of order brush, fictitious transactions and other means to interfere with risk assessment. Through the cross-validation mechanism and comprehensive analysis of multi-source data such as logistics, payment and evaluation, JD has improved the accuracy of fake transaction identification to 95%.

9.2. Fluctuation of performance ability of supply chain node enterprises

The complexity of supply chain leads to the uncertainty of the performance ability of node enterprises. Upstream suppliers may not be able to deliver on time due to raw material shortage, production accidents and other issues; Downstream dealers may delay sales collection due to changes in market demand. This fluctuation has a transmission effect, and the default of one node may trigger a chain reaction throughout the supply chain. For example, in the chip shortage event of 2022, the performance rate of many electronic parts suppliers decreased due to the shortage of raw materials, which in turn affected the production plans and repayment ability

of downstream manufacturers. By building a supply chain network risk model, Jingdong analyzes the importance and relevance of node enterprises, identifies the risk transmission path in advance, and makes dynamic credit adjustment to key suppliers.

9.3. Impact of macroeconomic and industry cycles

Macroeconomic environment and industry cycle have a significant impact on supply chain finance credit risk. During the economic downturn, the shrinking market demand leads to the decline of enterprise revenue and the weakening of repayment ability; Cyclical fluctuations in the industry (such as seasonal demand for fresh products) will also affect the stability of corporate cash flow. For example, during the epidemic, the default risk of supply chain enterprises in the catering industry increased significantly due to the sharp drop in consumer demand and the extension of receivables collection cycle. Jingdong dynamically adjusts the risk threshold and credit granting strategy by establishing a correlation model between macroeconomic indicators and industry prosperity. When the industry risk index exceeds the threshold, the system automatically reduces the credit line and shorts the repayment period to effectively avoid systemic risks.

10. Conclusion

This study explores JD supply chain finance's operation mode, credit risk assessment, and challenges. JD has evolved from a single - product service to a full - chain financial ecosystem through data assetization and technological innovation. Its dynamic risk control model, based on multi - source data and machine learning, excels in credit risk identification, speeding up approval and keeping the bad debt rate low while solving SMEs' financing problems.

The JD model's significance lies in providing technical standards, breaking traditional financial boundaries, and offering new ecological development ideas. However, the research has limitations, relying on public data and focusing on a single case. Future studies can focus on cross - border supply chain finance, ESG quantitative research, and multi - case comparisons to refine a more universal path for digital - age supply chain financial innovation.

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