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A Review of Blockchain Technology Adoption and Applications in Supply Chains

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Abstract: Blockchain technology offers a new approach to addressing information asymmetry, inefficient traceability, and high trust costs in supply chains through tamper-resistant records and end-to-end traceability. This paper reviews English-language research on blockchain adoption strategies, influencing factors, and supply chain applications. Existing studies show that adoption depends on technology costs, consumer perceptions, market competition, selling modes, and cost sharing, and subsequently affects pricing, information disclosure, and profitability. Whether blockchain creates value for supply chain members depends on whether the gains from more credible information cover technology investment and whether costs and benefits are allocated appropriately among members. Gaps remain in the treatment of off-chain data authenticity, consistent comparisons across competitive structures, and validation using real-world data. Joint decision mechanisms and dynamic adoption processes also require further investigation.

Keywords: Blockchain; Supply Chain Management; Technology Adoption; Information Disclosure; Market Competition.

1. Introduction

Supply chain products typically pass through production, processing, inspection, warehousing, logistics, and sales, with different participants recording information at each stage. Under conventional information disclosure arrangements, consumers find it difficult to verify product origins, quality conditions, and distribution processes. Fragmented data and inconsistent standards can also impose substantial trust and coordination costs on firms. Blockchain stores data through distributed records, cryptography, and consensus mechanisms. Its tamper resistance, traceability, and verifiability allow it to record product origins, quality inspections, production and processing, and logistics movements.

As blockchain is increasingly applied to product traceability, anti-counterfeiting certification, supply chain finance, and green information management, firms' adoption decisions and their economic consequences have attracted considerable attention. Blockchain can improve the credibility of disclosed information, but firms must also bear the costs of data collection, system integration, information storage, and operation and maintenance. A key consideration is therefore whether the market benefits of blockchain cover its adoption costs. Market competition, consumer perceptions, and supply chain structures further shape technology benefits and their distribution, producing different outcomes across settings.

Existing studies examine blockchain in supply chains through adoption strategies, influencing factors, and application scenarios. This review organizes the English-language literature around these three themes, summarizes the main findings in each area, and identifies research gaps and future directions.

2. Research on Blockchain Adoption Strategies

Research on blockchain adoption strategies primarily examines whether firms should adopt blockchain, which adoption arrangements they should choose, and how coordination mechanisms can realize its value. Early studies focused on comparisons between operating models. For luxury supply chains, Choi (2019) compares conventional retailing, blockchain platform sales, and conventional retailing integrated with blockchain, examining supply chain performance, costs, and transparency [1]. Subsequent research increasingly considers strategic interactions among competitors. Wang et al. (2022) develop a joint model of product information disclosure and blockchain adoption for two competing platforms when consumers question platform disclosures. They compare non-adoption by both platforms, unilateral adoption, and adoption by both. Adoption costs and consumers' beliefs about disclosed information jointly determine equilibrium choices, while blockchain changes optimal disclosure by improving information credibility [2].

As research settings expand, adopting participants, investment arrangements, and service provision have become additional analytical priorities. Wu et al. (2023) examine blockchain's application value and optimal adoption arrangements in a three-tier fresh agricultural product supply chain [3]. Li et al. (2023) compare conventional and blockchain-enabled fresh agricultural product supply chains and investigate the dynamic optimization of freshness-keeping effort, advertising effort, and the blockchain adoption degree [4]. Beyond product distribution, Ullah et al. (2023) examine post-sale customer care outsourcing by competing manufacturers. Incorporating consumer beliefs and adoption costs, they compare mutual adoption, mutual non-adoption, and differentiated adoption. Consumer beliefs and technology costs jointly determine equilibrium adoption regions. Even at low costs, firms may lack incentives to adopt when conventional services already enjoy strong consumer acceptance [5].

Later studies further investigate channel selection and the alignment of supply chain members' interests. Chen et al. (2024) consider two competing manufacturers selling through retail or direct channels. They compare building proprietary traceability systems with joining third-party blockchain

platforms and examine how consumers' traceability awareness and traceability levels affect profits and strategy choices [6]. Yu et al. (2024) study blockchain adoption and contract coordination in a poverty alleviation supply chain comprising a retailer with altruistic preferences and a farmers' cooperative [7]. Zhao et al. (2025) consider a competitive supply chain with a dominant retailer and two manufacturers producing imperfect substitutes. They analyze blockchain's effects on pricing, member performance, and coordination when manufacturers misreport costs [8].

Overall, blockchain adoption is an operating strategy jointly determined with disclosure, pricing, channel arrangements, and member coordination. Research has progressed from individual firms' adoption decisions to strategic interactions between competitors. Low costs generally encourage adoption, high costs discourage it, and intermediate costs may produce asymmetric equilibria with unilateral adoption. However, differences in supply chain structures and cost assumptions call for comparisons within a unified framework.

3. Factors Influencing Blockchain Adoption

After identifying adoption strategies, it is necessary to explain why adoption conditions vary across contexts. Relevant studies primarily consider internal costs, consumer responses, market competition, channel structures, and policy environments. Niu et al. (2021) examine multinational firms' decisions to provide quality verification through blockchain. They find that blockchain may increase returns from wholesale operations while reducing retail profits and tax-planning benefits, indicating different effects across business activities [9]. Pun et al. (2021) investigate manufacturers' blockchain strategies in relation to government incentives and the prevention of deceptive counterfeits [10]. Shen et al. (2022) subsequently show that permissioned blockchain can constrain counterfeiting while improving brand owners' profits, consumer surplus, and social welfare only when the novice consumer segment is sufficiently large [11].

Studies from the same period incorporate consumer traceability awareness, platform selling modes, and policy factors. Fan et al. (2022) find that adoption conditions depend on consumer traceability awareness, members' production costs, and technology usage costs. Revenue-sharing contracts can improve members' post-adoption returns under certain conditions [12]. Ma and Hu (2022) examine combinations of blockchain and selling modes in an internet platform-based closed-loop supply chain, showing that commission rates affect blockchain adoption and the choice between reselling and agency selling [13]. Cao and Shen (2022) investigate blockchain's effectiveness in preventing less sustainable products from entering cross-border supply chains, demonstrating that technology costs and mandatory adoption rules jointly determine governance outcomes [14]. Li et al. (2022) incorporate environmental taxes and retailers' fairness concerns into a green supply chain and find that blockchain adoption may weaken the positive effects of fairness concerns on supply chain performance [15].

Beyond these factors, subsequent research considers trade-offs between adoption benefits, environmental burdens, and privacy costs. Biswas et al. (2023) incorporate consumer distrust of product quality, blockchain costs, and environmental costs to compare traceability and sustainability [16]. Huang et al. (2023) study selling mode choices when e-commerce platforms use blockchain for information disclosure and find that consumer privacy concerns substantially affect adoption decisions [17].

Within the market competition literature, Ye et al. (2024) jointly consider technology costs and benefits to examine early adoption and follower adoption in two competing agri-food supply chains [18]. Zhou et al. (2024) further show that blockchain's added value depends on consumer acceptance, competition intensity, and cost-sharing proportions [19].

More recent studies examine these decisions in the context of decarbonization investment and different forms of competition. Zhao et al. (2026) investigate interactions among manufacturers' decarbonization investment, platform blockchain applications, and selling mode choices, showing that investment efficiency and selling modes alter members' gains from technology applications [20]. Lei and Yang (2026) compare blockchain adoption by duopolistic firms under Cournot and Bertrand competition. Competition intensity and unit blockchain operating costs jointly influence equilibrium adoption strategies, and symmetric firms may adopt different strategies under certain conditions [21].

Technology costs are thus the most consistent determinant of adoption, although cost thresholds vary with consumer trust, traceability awareness, privacy concerns, market competition, and channel arrangements. Low costs do not necessarily lead firms to adopt. The key issue is how much additional trust and market demand blockchain generates. Future research should distinguish fixed implementation costs, unit operating costs, and data verification costs, and examine how members share these costs.

4. Supply Chain Application Scenarios for Blockchain

These adoption conditions operate through different mechanisms across supply chain settings. Agricultural and food supply chains primarily face problems involving quality and safety, contamination liability, and transaction credibility. Niu et al. (2021) examine an agricultural supply chain with two competing suppliers and one retailer. Blockchain helps the retailer identify contamination liability, reduce costs, and strengthen its brand. High-quality suppliers obtain more orders and higher prices, whereas low-quality suppliers may incur additional contamination costs [22]. Cao et al. (2022) consider a two-tier agricultural supply chain comprising a cooperative and buyers and find that participation in a blockchain platform can increase output and total supply chain surplus [23]. Dong et al. (2023) further examine traceability technology adoption in food supply chain networks, focusing on members' incentives and the realization of expected benefits [24].

Whereas agricultural and food supply chains emphasize quality and safety, closed-loop supply chains and remanufacturing focus on the origins of recovered products and remanufacturing quality. Qiao et al. (2023) investigate manufacturers' blockchain adoption when serving green consumers, showing that traceable records can mitigate information asymmetry in product recovery [25]. Gong et al. (2023) analyze blockchain adoption and distribution channel selection by original equipment manufacturers competing with third-party remanufacturers [26]. These studies indicate that blockchain can improve consumer trust in recovery origins, remanufacturing processes, and product quality,

while technology costs and channel competition shape its economic value.

Beyond quality and recovery information, green and cross-border supply chains must communicate environmental attributes and compliance information to consumers. Xu et al. (2023) incorporate green consumer preferences, market segmentation, sales contract types, and blockchain-enabled transparency into cross-border e-commerce platform decisions. They examine relationships between platform adoption strategies and overseas manufacturers' green investment [27]. Lei and Yang (2026) extend adoption analysis to green competition with research and development risks, finding that the probability of successful green R&D and unit adoption costs jointly influence technology choices [28]. Such studies suggest that blockchain can support records of environmental attributes and compliance information. However, the reliability of on-chain records still depends on off-chain data collection, testing, and certification.

Overall, application settings differ in their information problems and stakeholder interests. Agricultural supply chains emphasize quality, safety, and contamination liability; closed-loop supply chains focus on recovery origins and remanufacturing quality; and green and cross-border supply chains emphasize environmental attributes and compliance. Existing research demonstrates broad potential applicability, but many models assume that original data are truthful and insufficiently address data entry errors, failures of third-party verification, and inconsistent data standards across participants.

5. Research Assessment and Future Directions

Existing studies explain blockchain's role in supply chain operations through adoption strategies, influencing factors, and application scenarios, yielding several broadly consistent findings. Blockchain improves the verifiability and traceability of product information and thereby affects consumer trust, demand, pricing, and members' profits. Adoption exhibits clear cost thresholds. Competition may strengthen the information advantage of unilateral adoption, but may also intensify price or disclosure competition when both parties adopt. An increase in total supply chain profit does not ensure that every member benefits; cost sharing and contract coordination influence whether implementation is feasible.

Several areas require further investigation. First, although some studies jointly examine consumer trust in information, product disclosure, and adoption, there is scope to consider off-chain data quality, the amount of information disclosure, and heterogeneous technology costs simultaneously. Second, studies separately examine one-to-one supply chains, downstream competition, and competition between supply chains, with limited consistent comparison across structures. Changes in the competitors and scope of competition may alter demand shifts and profit allocation, producing different adoption conditions. Third, despite research on dynamic decisions such as freshness-keeping effort, adoption mechanisms that jointly incorporate firm learning, declining technology costs, and accumulated consumer trust require deeper analysis. Finally, theoretical models dominate the literature, and empirical validation using operating data, consumer experiments, or cross-industry cases remains limited.

Future research can proceed in four directions. First, joint models of the amount of information disclosure, information credibility, and blockchain investment could identify when improved credibility encourages firms to disclose more or less information. Second, comparing one-to-one supply chains, downstream competition, and competition between supply chains within a common parameter framework could clarify how competitive structures affect adoption thresholds and profits. Third, incorporating original data quality, third-party certification, and accountability for erroneous information could distinguish record immutability from information truthfulness. Fourth, combining multiperiod decisions with real-world data could test relationships among technology costs, consumer trust, and demand, improving the explanatory power and applicability of research findings.

6. Conclusion

By improving the traceability and verifiability of supply chain information, blockchain offers a new approach to mitigating information asymmetry concerning product quality. Existing research indicates that adoption depends on technology costs, consumer perceptions, market competition, channel structures, and the allocation of costs and benefits among members. Blockchain does not necessarily increase disclosure or profits. Its value depends on whether the benefits of more credible information cover technology investment.

Research covers platform competition, agricultural supply chains, closed-loop supply chains, green supply chains, and cross-border trade. However, gaps remain in the interaction between disclosure and adoption, systematic comparisons across competitive structures, off-chain data authenticity, and empirical validation. Addressing these issues can help identify the conditions under which blockchain is appropriate and inform technology adoption and supply chain coordination.

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