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Research Article

Strategic Introduction of the Blockchain Technology under Retailing Competition from New Entrants

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Abstract: With the rapid development of blockchain technology, the new retail has diversified intelligent empowerment modes and achieved a leap change in the service system. As the competition in the retail industry becomes increasingly fierce, whether new entrants choose to introduce blockchain technology to improve their profits becomes the key to their development. This paper considers the system consisting of the incumbent retailer and the new entrant retailer, uses the game theory method to discuss their competition, considers the introduction cost of blockchain technology, and compares the two cases of the new entrant retailer not introducing blockchain technology and introducing blockchain technology. The results show that when the introduction of blockchain technology can fully make up for consumers' concerns about the quality of new entrant retailers' products and enhance consumers' trust in their products, new entrant retailers will choose to introduce blockchain technology. And only when the introduction cost of blockchain technology is less than a certain threshold, it is beneficial for new entrant retailers to introduce blockchain technology. Finally, some numerical examples are given to illustrate the correctness of the above conclusions.

Keywords: blockchain technology, the new entrant retailer, competitive strategy

1. Introduction

In recent years, China has continued to advance supply-side structural reform and optimize the economic structure. As the process of global economic integration and market competition are becoming more and more intensifying, retailing businesses are facing a more complex business environment. According to Forbes news, Apple has always been far ahead in the industry. However, its position has been challenged by the rise of Samsung and Huawei, among which Apple has lost about 10% share in the smartwatch market. Apple Watch shipments also fell 13% from 6 million in the first quarter of 2019 to 5.2 million in the first quarter of 2021 (Lamkin, 2020). From the perspective of consumers, incumbent retailers have existed in the market for a long time. They have a certain degree of dependence and trust in incumbent products (Li et al., 2019; Li et al., 2020; Zhou, Xu, et al., 2020). Therefore, consumers are more willing to buy products from incumbent retailers. In other words, incumbent retailers are in a profitable position to compete with new entrants.

However, this advantage often comes from the opacity of product information to consumers. Now, as an important frontier technology of modern digital technology (Liu & Tang, 2021), blockchain is an important transformative force of business model innovation, which has the advantages of decentralization, consensus sharing, non-repudiation, and

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improving supply chain transparency, building trust and reducing transaction costs. In March 2021, the *Outline of the 14th Five-Year Plan for National Economic and Social Development of the People's Republic of China and the Vision For 2035* reviewed and approved by the National Two Sessions has clearly listed blockchain as the key industry of the digital economy (XinhuaNet, 2021). In practice, blockchain technology has been recognized by the industry. Wal-Mart makes full use of blockchain to strengthen food supply chain safety controls by collaborating with IBM and Dole, which makes food quality and safety more credible.

To a certain extent, the introduction of blockchain technology can increase the transparency of product information (Wang et al., 2020), which means that the rise of blockchain technology may have an impact on the competition among these retailers. At the same time, new entrant retailers will also incur a large number of blockchain introduction costs (Öztürk & Yildizbaşi, 2020), which has become one of the important considerations for their blockchain introduction. Based on this, do new entrant retailers choose to introduce blockchain technology in the face of market competition? What are the sufficient conditions for the new entrant retailer to introduce blockchain technology? Therefore, the exploration of the above problems will provide a decision-making reference for the efficient operation of new retail enterprises.

2. Literature review

As the main focus of this paper is on the two aspects of blockchain technology and retailer competition, the following is a brief review of discussions and studies of various experts and scholars on these two aspects.

2.1 *A brief overview of blockchain*

With the rapid development of artificial intelligence technology, digital technology has become the key driving force of business model innovation (Chen, 2018). As an important frontier technology of modern digital technology, blockchain has become an important transformative force of business model innovation with its unique advantages. Blockchain can be defined as a database for users to share and enable users to trade valuable assets in a public or anonymous manner in the absence of a central database or intermediary (Glaser, 2017; Risius & Spohrer, 2017). At present, some scholars at home and abroad have researched the characteristics of blockchain. This paper systematically studied and analyzed the latest achievements of blockchain research, sorted it out from blockchain and its economic context, extended to the preliminary definition of blockchain economy, and deeply understood the basic principles and internal laws of blockchain economy (Zhang & Li, 2019). Blockchain has the characteristics of decentralization, trust-building based on consensus mechanism, and non-repudiation (Yuan & Wang, 2016). The functions and advantages of blockchain in systems of different industries are analyzed, guiding supply chain management (Tian et al., 2021). The Differences-in-Differences, Propensity Score Matching (DID+PSM) model was proposed to test and conclude that the application of blockchain can improve the operating efficiency of enterprises (Li & Wan, 2021). Some scholars have studied the financial risks of traditional supply chains and proposed an optimization model of supply chain financial risk control based on blockchain in combination with the advantages of blockchain technology (Fu et al., 2021). Blockchain technology plays an important role in promoting the transparency of social media information (Choi et al., 2020). The studies proposed that the introduction of blockchain in the supply chain will improve transparency and responsibility, and increase customers' trust in product features (Kshetri, 2018; Tian, 2016). In addition, some scholars discussed the sufficient conditions for supply chain enterprises to implement blockchain technology from multiple perspectives such as the introduction costs of blockchain. Wang et al. (2021) discussed the impact of consumer beliefs and the introduction cost of blockchain technology on the information disclosure strategy of competitive platforms. Li et al. (2021) show that luxury e-commerce platforms will choose blockchain technology for certification only if the difference between the cost of blockchain technology certification and the cost of manual technology certification is small.

2.2 *A brief overview of the retailing competition*

In the competition between retailers, scholars at home and abroad have also carried out certain research. A competitive game model was constructed between two retailers based on fairness concerns, comparing and analyzing

the behavioral differences between two retailers that fulfill social responsibilities and those that do not, which has a certain reference value for retailers' competitive decisions (Shu, 2019). Some scholars constructed four retailer strategy models: Cournot, Stackelberg, and two joint models, and obtained pricing decisions based on game competition of duopoly retailers under a green supply chain from the perspective of game theory through numerical analysis (Zhang et al., 2020). The pricing strategies of differentiated enterprises under duopoly competition were studied (Choudhary, 2010). A two-stage game model to study the price competition between e-commerce retailers and traditional retailers was used, proposing the optimal pricing and balanced profit respectively (Chen et al., 2006).

To sum up, some scholars have carried out a series of relevant analyses on the application of blockchain technology in supply chain management and price competition strategies of different retailers, but there is a lack of research on how blockchain technology affects competition between the incumbent retailer and the new entrant retailer. Therefore, based on the core characteristics of blockchain non-repudiation, openness, transparency, and decentralization, considering the introduction cost of blockchain technology, this paper intends to build a game model that the new entrant retailer does not introduce blockchain technology and introduces blockchain technology respectively, in order to expand the research of blockchain in supply chain management.

3. Problem description and model assumptions

Consider a system consisting of two different retailers, one of which is the incumbent retailer that has always existed, and the other is the new entrant retailer. To simplify writing, we use R_1 and R_2 to denote the incumbent retailer and the new entrant retailer respectively. Retailers introducing blockchain technology and those not introducing blockchain technology are denoted as B and N, respectively. We assume that the products sold by retailers are homogenous. And there is a degree of competition between them because they are in the same system. In order to further analyze the above problems, the following hypotheses are made:

i. It is assumed that all participants in the market are risk-neutral and their production and operation decisions are based on their own profit maximization (Zhou, Ma, et al., 2020).
ii. It is assumed that neither retailer R_1 nor retailer R_2 is eliminated from the market in the process of competition.
iii. It is assumed that consumers have no concerns about privacy disclosure caused by blockchain technology, that is, the utilities of consumers will not be reduced.
iv. It is assumed that consumers' valuation of the product is independent of the selling price of the product. Consumers value the products of retailer R_1 as v, which follows a uniform distribution from 0 to 1, i.e. $v \sim U(0,1)$. Then consumers value the products of retailer R_2 as θv, where $\theta < 1$. The reason is that the longer a retailer has been in the market, the more consumers trust and value its products.
v. It is assumed that the prices of products sold by retailer R_1 and retailer R_2 are p_1 and p_2, respectively.
vi. It is assumed that the introduction cost of blockchain technology is C.
vii. It is assumed that consumers' valuation of products is bv when the retailer introduces blockchain technology, where b represents the improvement of information transparency ($b > 1$). The reason is that consumers with more information can enhance their trust in the retailer and thus enhance their purchase intention.

Other relevant symbols: the utility obtained by consumers purchasing the retailer R_1's products is written as U_1, the utility obtained by consumers purchasing the retailer R_2's products is written as U_2; the demand of retailer R_1 is written as D_1, the demand of retailer R_2 is written as D_2; the profit of retailer R_1 is written as $\prod_1$, the profit of retailer R_2 is written as $\prod_2$; Superscript NN is the case where neither introduces blockchain technology, superscript NB is the case where the retailer R_1 does not introduce blockchain technology and the retailer R_2 introduces blockchain technology.

According to the above assumptions and symbol description, the retailers' profit expressions under the two conditions are as follows:

retailer R_1's profit:

$$\prod_1^{NN}(p_1) = p_1 D_1^{NN} \tag{1}$$

$$\prod_1^{NB}(p_1) = p_1 D_1^{NB} \tag{2}$$

retailer R_2's profit:

$$\prod_2^{NN}(p_2) = p_2 D_2^{NN} \tag{3}$$

$$\prod_2^{NB}(p_2) = p_2 D_2^{NB} - C \tag{4}$$

4. The establishment and solution of the model

4.1 *The entrant retailer R_2 does not introduce blockchain technology*

As mentioned above, consumers' purchasing decisions depend on their utilities to the product, and all consumers follow the principle of utility maximization to make purchase decisions (Zhou et al., 2015). The longer a retailer has been in the market, the more consumers trust its products. Then, the utility that consumers get from the incumbent retailer's products is $U_1^{NN} = v - p_1$ and the utility these consumers get from the new entrant retailer's products is $U_2^{NN} = \theta v - p_2$. Similar to Yan et al. (2018), consumers will choose to buy products from retailer R_1 if and only if the following conditions are satisfied:

$$\left\{\begin{array}{c} v - p_1 > \theta v - p_2 \Rightarrow v > \dfrac{p_1 - p_2}{1-\theta} \\ \theta v - p_2 > 0 \Rightarrow v > \dfrac{p_2}{\theta} \end{array}\right\} \tag{5}$$

Analogously, consumers will choose to buy products from retailer R_2 if and only if the following conditions are satisfied:

$$\left\{\begin{array}{c} \theta v - p_2 > v - p_1 \Rightarrow v < \dfrac{p_1 - p_2}{1-\theta} \\ v - p_1 > 0 \Rightarrow v > p_1 \end{array}\right\} \tag{6}$$

Therefore, we can obtain the demand functions $D_1^{NN} = 1 - \dfrac{p_1 - p_2}{1-\theta}$ and $D_2^{NN} = \dfrac{p_1 - p_2}{1-\theta} - \dfrac{p_2}{\theta}$, respectively, where $p_2 \le \theta p_1$. Moreover, when $p_2 > \theta p_1$, as the new entrant retailer, consumers have doubts about the quality of its products, which will lead to zero demand for the retailer, that is, R_2 is eliminated from the market.

Put the demand functions into equations (1) and (3) to obtain the profit functions of R_1 and R_2, respectively:

$$\prod_1^{NN}(p_1) = p_1\left(1 - \frac{p_1 - p_2}{1-\theta}\right) \tag{7}$$

$$\prod_2^{NN}(p_2) = p_2\left(\frac{p_1 - p_2}{1-\theta} - \frac{p_2}{\theta}\right) \tag{8}$$

Proposition 1. When retailer R_2 does not introduce blockchain technology, the decision results of the two retailers are as follows by solving the first-order conditions of the optimization problem:
i. The optimal price decisions of retailer R_1 and retailer R_2 are shown below:

$$p_1^{NN*} = \frac{2(1-\theta)}{4-\theta} \tag{9}$$

$$p_2^{NN*} = \frac{\theta(1-\theta)}{4-\theta} \tag{10}$$

ii. The optimal game demands of retailer R_1 and retailer R_2 are shown below

$$D_1^{NN*} = \frac{2}{4-\theta} \tag{11}$$

$$D_2^{NN*} = \frac{1}{4-\theta} \tag{12}$$

iii. The optimal profits of retailer R_1 and retailer R_2 are shown below:

$$\prod_1^{NN*} = \frac{4(1-\theta)}{(4-\theta)^2} \tag{13}$$

$$\prod_2^{NN*} = \frac{\theta(1-\theta)}{(4-\theta)^2} \tag{14}$$

Proposition 1. indicates that if the retailer R_2 does not introduce blockchain technology, the price and demand of R_2 are higher than that of R_1 and the corresponding profit is also higher than that of R_1. Even so, consumers still think the products of R_1 will bring them more utilities. As the new entrant retailer R_2 in the market, consumers will initially have doubts. Therefore, it is necessary for R_2 to develop low-cost strategies to ensure that it will not be eliminated from the market.

4.2 *The entrant retailer R_2 introduces blockchain technology*

Accordingly, the utility that consumers get from the incumbent retailer's products is $U_1^{NB} = v - p_1$ and the utility these consumers get from the new entrant retailer's products is $U_2^{NB} = b\theta v - p_2$. Similarly, If and only if $U_1^{NN} > \max\{0, U_2^{NN}\}$, consumers will choose to buy products from retailer R_1 or not; if and only if $U_2^{NN} > \max\{0, U_1^{NN}\}$, consumers will choose to buy products from retailer R_2 or not.

At this point, it is particularly important whether the introduction of blockchain technology can improve consumers' valuation of products, that is, the value of $b\theta$ will affect the retailer's optimal decision, so the discussion is divided into three cases:

Case 1. If $b\theta < 1$, that is, the introduction of blockchain technology does not compensate for consumer concerns about the quality of the product of the new entrant retailer. Similar to Section 4.1, the demand of R_1 is $D_1^{NB} = 1 - \frac{p_1 - p_2}{1-b\theta}$, where $p_2 \le b\theta p_1$; the demand of R_2 is $D_2^{NB} = \frac{p_1 - p_2}{1-b\theta} - \frac{p_2}{b\theta}$, where $p_2 \le b\theta p_1$.

Put the demand functions into equations (1) and (3) to obtain the profit functions of R_1 and R_2 respectively:

$$\prod_1^{NB}(p_1) = p_1(1-\frac{p_1-p_2}{1-b\theta}) \tag{15}$$

$$\prod_2^{NB}(p_2) = p_2(\frac{p_1-p_2}{1-b\theta}-\frac{p_2}{b\theta})-C \tag{16}$$

Proposition 2. When retailer R_2 introduces blockchain technology in the case of $b\theta < 1$, the decision results of the two retailers are as follows by solving the first-order conditions of the optimization problem:
i. The optimal price decisions of retailer R_1 and retailer R_2 are shown below:

$$p_1^{NB*} = \frac{2(1-b\theta)}{4+b\theta} \tag{17}$$

$$p_2^{NB*} = \frac{b\theta(1-b\theta)}{4+b\theta} \tag{18}$$

ii. The optimal game demands of retailer R_1 and retailer R_2 are shown below:

$$D_1^{NB*} = \frac{2(1+b\theta)}{4+b\theta} \tag{19}$$

$$D_2^{NB*} = \frac{1}{4+b\theta} \tag{20}$$

iii. The optimal profits of retailer R_1 and retailer R_2 are shown below:

$$\prod_1^{NB*} = \frac{4(1+b\theta)(1-b\theta)}{(4+b\theta)^2} \tag{21}$$

$$\prod_2^{NB*} = \frac{b\theta(1-b\theta)}{(4+b\theta)^2}-C \tag{22}$$

Proposition 2. indicates that when retailer R_2 introduces blockchain technology in the case of $b\theta < 1$, retailer R_2's profit does not obviously increase and it also has to pay a large cost of blockchain technology introduction. Therefore, the new entrant retailer will not choose to introduce blockchain technology.

Case 2. If $b\theta = 1$, that is, the introduction of blockchain technology just makes up for consumers' concerns about the product quality of the new entrant retailer, making that the consumer values retailer R_1's products the same as retailer R_2's. At this point, no matter the retailer R_1 or R_2 reduce the selling price, the demand of another retailer will be 0, and there is only one retailer in the market.

Case 3. If $b\theta > 1$, in other words, the introduction of blockchain technology can completely make up for consumers' concerns about the quality of the product of the new entrant retailer, and it can also provide consumers with more product quality information and enhance the trust of the consumer in its products. Similar to Section 4.1, at this point, the demand of R_1 is $D_1^{NB} = \frac{p_2-p_1}{b\theta-1}-p_1$, where $p_2 > b\theta p_1$; the demand of R_2 is $D_2^{NB} = 1-\frac{p_2-p_1}{b\theta-1}$, where $p_2 > b\theta p_1$.

The reason is that consumers value retailer R_2's products more than R_1, which will lead to zero demand for retailer R_1 if $p_2 \le b\theta p_1$, that is, R_1 is eliminated from the market.

Put the demand functions into equations (2) and (4) to obtain the profit functions of R_1 and R_2 respectively:

$$\prod_1^{NB}(p_1) = p_1(\frac{p_2 - p_1}{b\theta - 1} - p_1) \tag{23}$$

$$\prod_2^{NB}(p_2) = p_2(1 - \frac{p_2 - p_1}{b\theta - 1}) - C \tag{24}$$

Proposition 3. When retailer R_2 introduces blockchain technology in the case of $b\theta > 1$, the decision results of the two retailers are as follows by solving the first-order conditions of the optimization problem:
i. The optimal price decisions of retailer R_1 and retailer R_2 are shown below:

$$p_1^{NB*} = \frac{b\theta - 1}{4b\theta - 1} \tag{25}$$

$$p_2^{NB*} = \frac{2b\theta(b\theta - 1)}{4b\theta - 1} \tag{26}$$

ii. The optimal game demands of retailer R_1 and retailer R_2 are shown below:

$$D_1^{NB*} = \frac{b\theta}{4b\theta - 1} \tag{27}$$

$$D_2^{NB*} = \frac{2b\theta}{4b\theta - 1} \tag{28}$$

iii. The optimal profits of retailer R_1 and retailer R_2 are shown below:

$$\prod_1^{NB*} = \frac{b\theta(b\theta - 1)}{(4b\theta - 1)^2} \tag{29}$$

$$\prod_2^{NB*} = \frac{4b^2\theta^2(b\theta - 1)}{(4b\theta - 1)^2} - C \tag{30}$$

From **Proposition 3**, for the new entrant retailer R_2, when $\prod_2^{NB*} > \prod_2^{NN*}$ that is $C < \frac{4b^2\theta^2(b\theta - 1)}{(4b\theta - 1)^2} - \frac{\theta(1-\theta)}{(4-\theta)^2}$, the retailer will choose to introduce blockchain technology.

5. Numerical examples

In order to verify the results of the above decision model, according to the above assumptions and properties, parameters are assigned as follows, and numerical examples are used to further demonstrate the correctness of the above conclusions. We set $\theta = 0.6$, when $b\theta < 1$, b = 1.1; when $b\theta > 1$, $b = 3$.

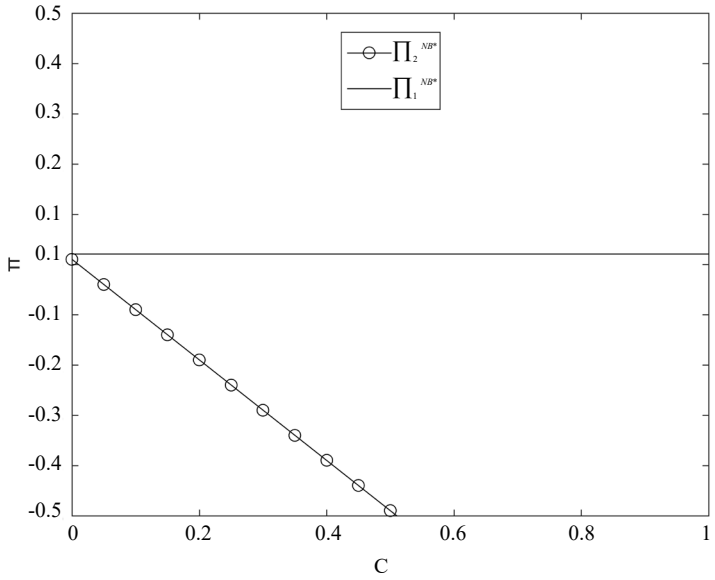

Figure 1. Schematic diagram of R_2's optimal profit changing with C when $b\theta < 1$

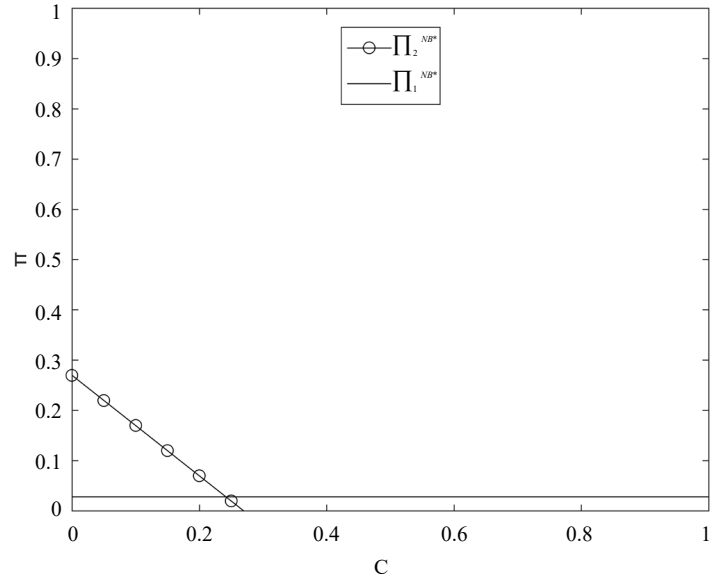

Figure 2. Schematic diagram of R_2's optimal profit changing with C when $b\theta > 1$

As shown in **Figure 1**, the entrant retailer R_2 introduces blockchain technology, which does not make up for consumers' concerns about the quality of products. Consumers' demand for its products is still less than that of the retailer R_1. At this point, the retailer has to pay the cost of introducing the blockchain. Therefore, the entrant retailer will not introduce blockchain technology. As shown in **Figure 2**, the introduction of blockchain technology could more than compensate for consumer concerns about the quality of products. At this point, the retailer's profit decreases with the increase in the cost of introducing blockchain technology. When the cost exceeds a certain value, the retailer will not choose to introduce blockchain technology.

6. Conclusion

Blockchain technology continues to develop rapidly and has become one of the important technologies for social transformation in the future. In the new retail industry, the introduction of blockchain technology will affect the profits and comprehensive competitiveness of new entrant retailers. Based on this, this paper builds a competitive game model between incumbent retailer and new entrant retailer, considers the introduction cost of blockchain technology, compares and analyzes the differences in decision-making results under two situations where new entrant retailer does not introduce blockchain technology and introduces blockchain technology, and explores sufficient conditions where new entrant retailer introduce blockchain. The main conclusions are as follows:

i. When the introduction of blockchain technology can completely make up for consumers' concerns about the quality of new entrant retailer's products, and can also provide consumers with more product quality information and enhance consumers' trust in products, new entrant retailers will consider introducing blockchain technology.
ii. There is a cost threshold for blockchain introduction. When and only when the introduction cost of blockchain technology is below the threshold, new entrant retailers can make greater profits in the competition. After exceeding the threshold, profits will begin to decline, and rational new entrant retailers will not choose to introduce blockchain technology.
iii. Under the sufficient condition that the new entrant retailer is willing to introduce blockchain, the core competitiveness of the new entrant retailer will be enhanced by introducing blockchain technology. This shows that the introduction of blockchain technology will increase consumer demand, which has led to a significant increase in retailer profits.

From the above conclusions, the following management suggestions are obtained:

i. The essence of retailer competition is to compete for customers. In the era of the digital economy, if new entrant retailers want to be in an advantageous position in the competition, they must play the role of data elements fully, improve consumers' trust in products, and expand the market demand for products.
ii. New entrant retailers should fully consider the threshold of the introduction cost of blockchain technology. When the introduction cost is less than the threshold, new entrant retailers can increase corporate profits by introducing blockchain technology. Conversely, high introduction cost will harm their own interests.
iii. The characteristics of blockchain decentralization, traceability, and permanent tampering can digitize and securely store data of all transactions and products - from source to shelf, and then return to shelves. The information is visible in real-time, so consumers can accurately witness the products being produced, transported, and sold at any given time. In addition, the information recorded in the distributed ledger is tamper-proof, because any change is impossible without the consent of the whole network, which ensures the authenticity of the data and improves production. The transparency of product information enhances the trust of consumers, which will inevitably greatly change the ecology of the retail industry, tap the consumption potential, and promote the explosion of consumer demand.

However, the research of this paper also has many limitations. There are only two retailers in the market, the typicality is not enough; only considering that all participants in the supply chain are risk-neutral; consumers' concerns about their privacy disclosure were not taken into account. These will be the direction of further research in the future.

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Conflict of interest statement

All authors have no conflict of interest.

References

Choi, T., Guo, S., & Luo, S. (2020). When blockchain meets social-media: Will the result benefit social media analytics for supply chain operations management? *Transportation Research Part E: Logistics and Transportation Review*, *135*(C), 101860. https://doi.org/10.1016/j.tre.2020.101860

Choudhary, V. (2010). Use of pricing schemes for differentiating information goods. *Information Systems Research*, *21* (1), 78-92. https://doi.org/10.1287/isre.1080.0203

Chen, X. (2018). Trend analysis of technology fusion and application innovation in the digital economy era. *Journal of Central South University (Social Science Edition), 24*(05), 1-8. https://doi.org/10.11817/j.issn.1672-3104.2018.05.001

Chen, Y., Wang, H., & Shen, H. (2006). Study on the Price Competition between E-commerce Retailer and Conventional Retailer. *Systems Engineering-Theory & Practice, 26*(01), 35-41. https://doi.org/10.3321/j.issn:1000-6788.2006.01.0057

Fu, H., Zhang, F., Su, Z., Han, Y., & Wu, Y. (2021). Application of blockchain technology in supply chain financial risk management. *Fiscal Science*, (02), 152-160. https://doi.org/10.19477/j.cnki.10-1368/f.2021.02.016

Glaser, F. (2017). Pervasive Decentralisation of Digital Infrastructures: A Framework for Blockchain enabled System and Use Case Analysis. In *Proceedings of the 50th Hawaii International Conference on System Sciences*. SSRN. https://ssrn.com/abstract=3052165

Kshetri, N. (2018). 1 Blockchain's roles in meeting key supply chain management objectives. *International Journal of Information Management, 39*(4), 80-89. https://doi.org/10.1016/j.ijinfomgt.2017.12.005

Li, C., Chu, M., Zhou, C., & Xie, W. (2019). Is it always advantageous to add-on item recommendation service with a contingent free shipping policy in platform retailing? *Electronic Commerce Research and Applications, 37*, 1-11. https://doi.org/10.1016/j.elerap.2019.100883

Li, C., Chu, M., Zhou, C., & Zhao, L. (2020). Two-period discount pricing strategies for an e-commerce platform with strategic consumers. *Computers and Industrial Engineering, 147*, 1-13. https://doi.org/10.1016/j.cie.2020.106640

Li, G., Fan, Z., & Wu, X. (2021). The Choice Strategy of Authentication Technology for Luxury E-Commerce Platforms in the Blockchain Era. *IEEE Transactions on Engineering Management,* 1-14. https://doi.org/10.1109/TEM.2021.3076606

Li, R., & Wan, Y. (2021). The impact of blockchain on enterprise operational efficiency -- Trust Booster or Hype? *Friends of Accounting,* (01), 153-160. https://kns.cnki.net/kcms/detail/14.1063.F.20201227.1005.046.html

Liu, T., & Tang, K. (2021). Blockchain Enabling New Retailing: Research Focus and Theoretical Framework. *Consumer Economics, 37*(06), 81-90. https://kns.cnki.net/kcms/detail/43.1022.F.20210906.1448.002.html

Lamkin, P. (2020, June 26). *Apple faces threat from Huawei and Samsung for smartwatch dominance*. Forbes. https://www.forbes.com/sites/paullamkin/2020/06/26/apple-faces-threat-from-huawei-and-samsung-for-smartwatch-dominance/?sh=1237633946c0

Öztürk, C., & Yildizbaşi, A. (2020). Barriers to implementation of blockchain into supply chain management using an integrated multi-criteria decision-making method: a numerical example. *Soft Computing, 24*, 14771-14789. https://doi.org/10.1007/s00500-020-04831-w

Risius, M., & Spohrer, K. (2017). A Blockchain Research Framework: What We (Don't) Know, Where We Go from Here, and How We Will Get There. *Business and Information Systems Engineering*, 59, 385-409. https://doi.org/10.1007/s12599-017-0506-0

Shu, S. (2019). The Competition of Two Retailers with Corporate Social Responsibility under Fairness Concerns. *Journal of jiangxi normal university (natural science), 43*(04), 361-367. https://doi.org/10.16357/j.cnki.issn1000-5862.2019.04.06

Tian, F. (2016). An Agri-food Supply Chain Traceability System for China Based on RFID & Blockchain Technology. In *2016 13th International Conference on Service Systems and Service Management* (pp. 1-6). IEEE. https://doi.org/10.1109/ICSSSM.2016.7538424

Tian, Y., Chen, Z., Song, X., & Li, T. (2021). Overview of Blockchain Application in Supply Chain Management. *Computer Engineering and Applications, 57*(19), 70-83. https://doi.org/10.3778/j.issn.1002-8331.2105-0136

Wang, Q., Chen, Z., & Wang, P. (2020). Application of blockchain technology in the new retail supply chain. *Journal of Commercial Economics,* (14), 34-36. https://doi.org/10.3969/j.issn.1002-5863.2020.14.009

Wang, Y., Tao, F., & Wang, J. (2021). Information Disclosure and Blockchain Technology Adoption Strategy for Competing Platforms. *Information & Management,* 103506. https://doi.org/10.1016/j.im.2021.103506

XinhuaNet. (2021, March 13). *Outline of the 14th Five-Year Plan for National Economic and Social Development of the*

People's Republic of China and the Vision For 2035. http://www.xinhuanet.com/2021-03/13/c_1127205564_10.htm

Yuan, Y., & Wang, F. (2016). Blockchain: The State of the Art and Future Trends. *Acta Automatica Sinica, 42*(04), 481-494. https://doi.org/10.16383/j.aas.2016.c160158

Yan, Y., Zhao, R., & Liu, Z. (2018). Strategic introduction of the marketplace channel under spillovers from online to offline sales. *European Journal of Operational Research, 267*(1), 65-77. https://doi.org/10.1016/j.ejor.2017.11.011

Zhou, C., Tang, W., & Zhao, R. (2015). Optimal consumer search with prospect utility in hybrid uncertain environment. *Journal of Uncertainty Analysis and Applications, 3*(6), 1-20. https://doi.org/10.1186/s40467-015-0030-z

Zhou, C., Xu, G., & Liu, Z. (2020). Incentive contract design for internet referral services: Cost per click vs cost per sale. *Kybernetes, 49*(2), 601-626. https://doi.org/10.1108/K-07-2018-0371

Zhou, C., Ma, N., Cui, X., & Liu, Z. (2020). The impact of online referral on brand market strategies with consumer search and spillover effect. *Soft Computing, 24*(4), 2551-2565. https://doi.org/10.1007/s00500-018-3661-4

Zhang, L., & Li C. (2019). Research progress of blockchain economy. *Economic Dynamics,* (04), 112-124. https://affhc975c3444c2dc4daas09pb95xfuvko6c66fffi.res.gxlib.org.cn/periodical/ChlQZXJpb2RpY2FsQ0hJTmV3UzIwMjIwNDE1Eg5qanhkdDIwMTkwNDAwOBoINHNjengxdTQ=

Zhang, Q., Yang, J., Duan, J., & Qin, J. (2020). Pricing decision of green supply chain under the game competition of duopolistic retailers. *Journal of Southeast University (English Edition), 36*(04), 465-474. https://doi.org/10.3969/j.issn.1003-7985.2020.04.012