Journal of Intelligent Management Decision
https://www.acadlore.com/journals/JIMD

Dual-Channel Supply Chain Pricing Decisions for Low-Carbon Consumers: A Review

Chenjin Song[1,2*], Baojian Xu[1], Ling Xu[2,3]

[1] School of Management Science and Engineering, Chongqing Technology and Business University, 400030 Chongqing, China
[2] International College, National Institute of Development Administration, 10240 Bangkok, Thailand
[3] School of Transportation Management, Jiangxi Vocational and Technical College of Communications, 330013 Nanchang, China

[*] Correspondence: Chenjin Song (2022336010@email.ctbu.edu.cn)

Received: 02-16-2023 **Revised:** 04-20-2023 **Accepted:** 04-30-2023

Citation: C. J. Song, B. J. Xu, and L. Xu, "Dual-channel supply chain pricing decisions for low-carbon consumers: A review," *J. Intell Manag. Decis.*, vol. 2, no. 2, pp. 57–65, 2023. https://doi.org/10.56578/jimd020202.

Abstract: As environmental awareness grows, consumers' green and low-carbon preferences have become essential factors for market enterprises to consider in decision-making. This paper conducts a literature review of dual-channel supply chain pricing decisions under the influence of consumers' low-carbon preference. The analysis is carried out from two aspects: dual-channel supply chain types and consumers' low-carbon preference. By combining psychological games and analyzing relevant literature, this paper provides insights into the factors that affect consumers' low-carbon preference and explores the synergies among various factors, including government policies. Moreover, this paper suggests future research directions, such as conducting empirical research on relevant models, to support the diversified development of the dual-channel field.

Keywords: Dual-channel supply chain; Consumers' low-carbon preference; Pricing decision; Multi-stage game; Recycling and remanufacturing

1 Introduction

In the current era of "Internet +", businesses are constantly innovating their models, and as information technology rapidly develops, the security and control environment also continues to improve. With the convenience of obtaining commodity information online and the ease of evaluation, the electronic market has become the core of commodity purchase and sale on the Internet, leading to a gradual shift of consumers' shopping channels online. This digital transformation has prompted most enterprises to fully integrate various sales channels, combining traditional offline retail channels with online sales channels, and using digital technology to accurately target specific consumer groups for their products. This enables efficient matching of the needs of corresponding consumer groups with personalized, high-quality, and excellent services, providing them with a multi-channel operation mode that is systematic, organized, and comfortable [1].

However, the newly developed dual-channel model currently conflicts with the existing traditional retailer market due to various factors such as channel and price competition, despite its benefits of providing a good shopping experience, efficient use of existing resources, and optimization of supply chain efficiency [2]. In addition, consumers' awareness of green environmental protection has increased significantly, leading to changes in consumption channels and consumer consumption concepts [3]. Therefore, manufacturers or suppliers must make corresponding changes to maintain competitiveness. Enterprises must balance the pricing decision-making issues of online and offline channels to realize the harmonious coexistence and stable development of the green dual channels composed of online and offline channels.

Although there are many literatures on the decision-making problem of dual-channel supply chain, including supply chain member decision-making, coordination decision-making, service decision-making, production decision-making, etc., there is still relatively little research on pricing decisions in dual-channel supply chains under consumers' low-carbon preference. This paper aims to provide insights into this area. It mainly selects relevant literature on the pricing decision of the dual-channel supply chain under the influence of consumers' low-carbon

preference and reviews and summarizes the current research methods of the dual-channel supply chain under the influence of this factor. The paper also provides ideas and innovative directions for future research of dual-channel supply chain, especially the dual-channel supply chain under the influence of consumers' low-carbon preference.

This section sorts out the literature on research methods for dual-channel supply chain pricing decision-making and discusses the dual-channel type and consumers' low-carbon preference by category. Looking at the literature on dual-channel supply chain decision-making under the influence of different preferences in recent years, pricing decision-making is the most widely studied direction. With the insights gained from analyzing and summarizing existing research, this paper hopes to provide valuable contributions to the dual-channel supply chain literature and identify areas for future research.

2 Dual-Channel Supply Chain Structure

The sudden addition of online channels has greatly impacted the traditional supply chain, resulting in scarcity of resource allocation and profit squeeze. This has led to a double free riding effect between manufacturers and traditional distributors, contributing to the emergence of channel conflicts from various perspectives. The impact of these conflicts is not only on promotional strategy efforts but also on the efficiency of the entire supply chain, as well as the utilization of market resources. Therefore, resolving conflicts between dual channels and coordinating the supply chain has become a key challenge that manufacturers and retailers must address.

2.1 Traditional Supply Chain

When shopping, consumers are faced with the choice of traditional retail channels or online channels. For manufacturers or retailers, identifying the factors that influence consumers' channel choices is crucial. Cai [4] explored the influence of channel structure and coordination of product supply chains on manufacturers, retailers, and supply chains. Ji et al. [5] used dynamic programming theory in operations research and differential game theory in game theory to construct reference factors for consumers' online reviews, inventory evaluation factors for different offline retailers, and influence models of different individuals' personality preferences for the two channels on supply chain operations. Yang et al. [6] found that for some products with insignificant differences that can be replaced by out-of-stock, "two-way free riding" situations will inevitably arise when both offline and online channels exist, whether it is the manufacturer or the retailer. For instance, a common phenomenon when purchasing clothes or other products is that customers visit their local physical store to understand the type and size of the clothes and try them on. If they are suitable, they will choose to buy online because online prices are lower. This is a typical free-riding case of a manufacturer on a retailer, which greatly impacts physical retail stores [6] and has attracted the attention of many scholars.

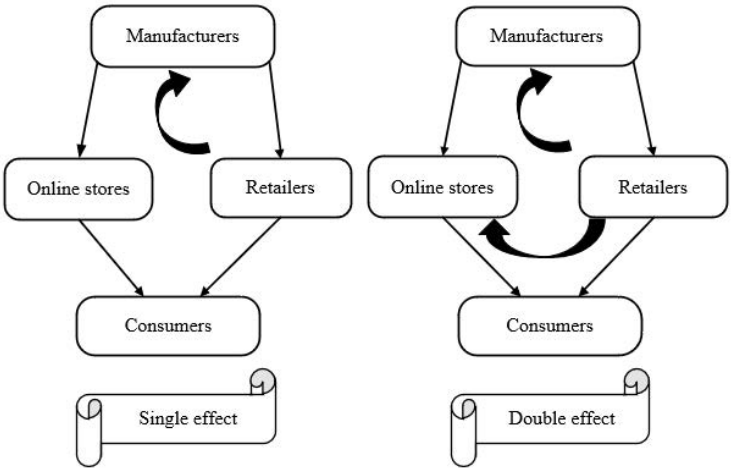

Figure 1. Comparison chart of single and double free riding effect

Zhou and Zhao [7] investigated the wholesale or retail pricing strategy of manufacturers and retailers in a dual-channel supply chain under the assumption that only retailers have disclosed information regarding single and dual free-rider effects (as shown in Figure 1). Xing and Liu [8] explored the impact of the "free-riding" behavior of consumers on the sales investment efforts of manufacturers and retailers, and its effect on supply chain profits. Zhang et al. [9] established a two-stage pricing and service level decision-making model for the implementation of discriminatory pricing through dual channels. They used consumer utility, optimization theory, and game theory to analyze the impact of consumer free-riding and discriminatory pricing on the dual-channel supply chain.

Building on the existing research, Wang [10] studied the pricing decision-making and contract coordination mechanism of a dual-channel low-carbon supply chain composed of a single manufacturer and retailer, using the Stackelberg game and mathematical model. They examined this under different power structures. Geng and Mallik [11] studied the compensation incentives of manufacturers to retailers under the assumption that the retailers are the leader of the Stackelberg strategy game. They effectively alleviated the coordination of supply imbalances in dual supply chains by combining reverse revenue sharing contracts and transfer payments. This maximized retailers' profits while constrained resource and production efficiency, at least without compromising manufacturers' existing profits. The research conducted by Geng and Mallik [11] provides a useful framework for managing the supply chain and pricing decisions in a dual-channel environment, particularly in cases where there is a power asymmetry between manufacturers and retailers.

2.2 Closed-Loop Supply Chain

As the traditional economic development model shifts towards the circular economy model, there is an increased focus on the recycling and manufacturing of waste products. In this context, a new supply chain model, the dual-channel closed-loop supply chain, has emerged. This model combines various types of reverse supply chains, such as consumer-retailer-manufacturer or consumer-manufacturer, with the traditional supply chain. The result is an organic combination that enables sustainable recycling of resources and the development of a new dual-channel marketing model.

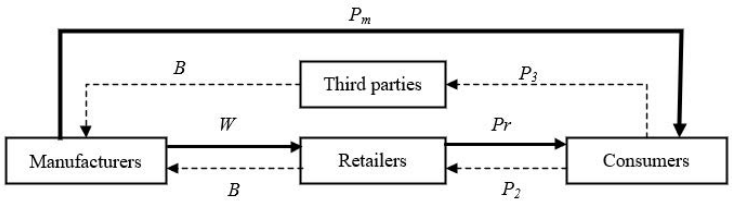

Figure 2. Multi-channel recycling closed-loop supply chain model

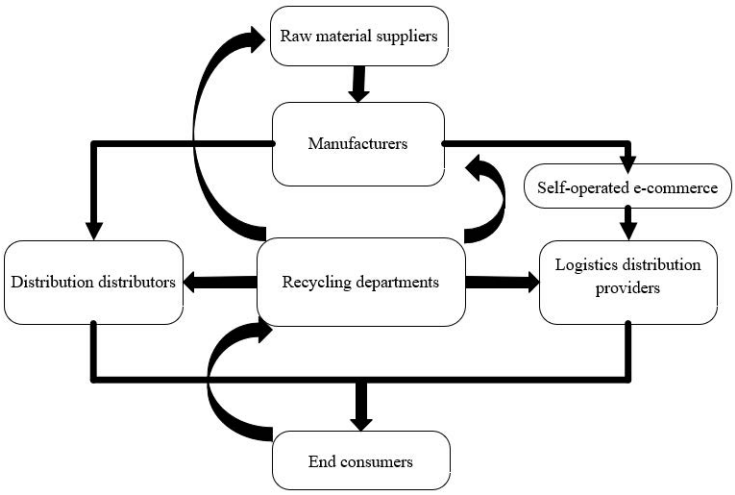

Figure 3. Closed-loop supply chain of consumers with different preferences for dual channels under reverse logistics recycling

American automobile manufacturers have set a great example by actively remanufacturing waste products, which not only generates good economic benefits but also earns a positive reputation in society. In a closed-loop supply chain, selecting the appropriate recycling channels is crucial for constructing a sustainable recycling system. Chen et al. [12] established a multi-channel recycling closed-loop supply chain model using the Stackelberg game under four reward and punishment mechanisms (as shown in Figure 2). They studied the decision-making of manufacturers and recycling departments in retailer-led closed-loop supply chains under this mechanism. Rayati et al. [13] evaluated the recycling strategy and optimal pricing under two competitive recycling channels of retailers and third parties. Saha et al. [14] studied the dual-channel closed-loop supply chain decision-making problem under the assumption that the recycling volume is non-linear dependent on the recycling price. They compared the supply chain profits of

three recycling models. Building on this research, Zheng et al. [15] extended the classic closed-loop supply chain game model with recovery rates as the decision-making variable to a dual-channel closed-loop supply chain.

Furthermore, scholars have also conducted research on government policy guidance, such as trade [16], subsidizing consumers, and the government collecting a certain fund from manufacturers to subsidize recyclers [17]. Niu [18] developed a dual-channel closed-loop supply chain based on consumers' different preferences for traditional retail channels and electronic channels (as shown in Figure 3). They took into account reverse logistics after the sale of goods and secondary sales costs after maintenance. By constructing the manufacturer-led Steinberg game model under information asymmetry, the Bochuander game model with a balance between manufacturers and retailers, and the Pareto optimal decision-making model under complete information conditions, and then introducing the contract coordination mechanism, they obtained the optimal decision-making model. They found that consumers' preference for online channels is not related to the wholesale price given by manufacturers to retailers but is related to total profits [18].

These studies are in line with the current green policies of the government and the market. They have systematically enriched the theoretical and methodological system of pricing and decision-making in the closed-loop supply chain of dual-channel recycling. This is of great significance for future scholars researching this field.

3 Research on Dual-Channel Supply Chain Based on User Behaviors

3.1 Consumer Channel Preference

Most of the scholars mentioned earlier focus on the structure of the dual-channel supply chain. However, some scholars combine the dual-channel structure with consumer behavior psychology. This includes studies on consumer psychology, retailer psychology, manufacturer psychology, and a comprehensive study of the three. For instance, Gao [19] uses psychological cost as an explanatory variable to study the relationship between the price difference of products in dual channels and the psychological cost of online shopping. They investigate its impact on corporate profits and confirm the existence of psychological cost of online shopping through empirical testing. Additionally, they analyze the main factors affecting the psychological cost of consumer online shopping, providing a new direction for enterprises to capture market share and promote products.

Some scholars believe that under the condition of incomplete information, some consumers show the psychological bias of overconfidence. Therefore, they study the impact of consumer overconfidence on and sensitivity to retailer profits under different circumstances using the theory of consumer utility and the relevant model of dual-channel retailer pricing decision-making. In contrast, Shen et al. [20] divide consumer groups based on the comparison shopping behavior of consumers. They construct a single-channel and dual-channel supply chain decision-making model and analyze the profit function of supply chain members under the two models using game theory. Their results show that the existence of online consumers will reduce the profits of retailers, and the conflict between the dual channels will also intensify [21].

To analyze the pricing strategies of retailers with risk-averse behaviors, Wang [22] establishes the pricing strategy model of the Stackelberg game using the average price difference pricing strategy under the condition that consumers have different preferences for dual channels. Hong et al. [23] study the problem of recycling channel selection under the influence of the psychological state of decision makers and the risk preference factors of manufacturers and retailers under the condition of inaccurate information. They analyze the competition and cooperation between manufacturers and retailers from the perspective of revenue stream risk, and study how to achieve supply chain coordination, Pareto improvement, and reasonable distribution of system performance. Li et al. [24] analyze the pricing and revenue under the symmetry and asymmetry of dual-channel supply chain information without fair concerns, using the Starckerberg game and wholesale price discount and cost sharing contract model.

In addition to the studies of various aspects by the above-mentioned scholars, there are also some scholars who comprehensively consider the mixed model analysis of multiple factors. For example, Liang and Zhang [25] consider the green preference and dual-channel preference of consumers, as well as the innovation input cost of emission reduction in the supply chain when manufacturers dominate and only manufacturers carry out carbon emissions. They construct the Stackelberg game model for three supply chain structures, i.e., the traditional offline single retail channel, offline retailer distribution and online direct sales dual channel, and offline retailer distribution and online retailer distribution dual channel. They study the optimal pricing strategy decision and the dual-channel profit analysis strategy of each member of the supply chain under the consideration of only the manufacturer's emission reduction strategy.

If the dual-channel model operates correctly, it can greatly increase the sales and recycling of market products, improve the remanufacturing capacity of the supply chain, achieve low-carbon environmental protection and efficient use of resources, and gain more profits. However, there are also some hidden dangers in this model. The conflicting competition between the two channels for market share may reduce the efficiency of the supply chain. Therefore, Wang and Hu [26] constructed a dynamic model of supply chain combining online and offline. They studied the

optimal service and pricing decisions under centralized and decentralized decision-making modes to achieve supply chain coordination.

3.2 Consumers' Low-Carbon Preference

In addition to the studies on the structure and decision-making of dual-channel supply chains, there are currently many studies considering the impact of consumer preference factors on the dual-channel supply chain. Scholars are increasingly interested in the issue of supply chain emission reduction. Many researchers have studied the direct impact of consumers' low-carbon preference factors on the dual-channel sales of products or the indirect impact of certain environmental protection behaviors, such as recycling and remanufactured products, on corporate decision-making and green and low-carbon supply chains.

Moreover, scholars have investigated the effects of consumer preferences on the pricing strategy of dual-channel supply chains. They have considered the impact of consumers' low-carbon preference factors on pricing decisions and profits in dual-channel supply chains. By doing so, they have identified ways to promote the sales of low-carbon and environmentally friendly products in the dual-channel supply chain.

Overall, the studies on the impact of consumer preferences on the dual-channel supply chain have enriched the theoretical and methodological system of pricing and decision-making in the green and low-carbon supply chain. They provide a foundation for future research in this field.

3.2.1 Direct impact

Moreover, many scholars have conducted systematic studies on the impact of consumers' low-carbon preferences on the profits of manufacturers and retailers. They have used methods such as evolutionary games and numerical simulations to draw meaningful management implications for subsequent research on low-carbon supply chains.

For instance, Liu et al. [27] studied the impact of different contracts provided by manufacturers on the low-carbon supply chain under the condition that retailers have fair preference. Plambeck [28] verified that disclosing green information related to products can improve market share and profits for enterprises with a high green reputation or those focusing on marketing green and low-carbon products. Chen [29] believed that the terminal-oriented customer preference behavior of the products produced by an enterprise determines the production mode of the enterprise and the competition or cooperation among enterprises.

The way a country or specific local government views the ecological environment and its related policies largely affects consumers' preference for low-carbon products. This, in turn, determines the awareness and improvement of low-carbon supply chain construction in the production and operation process of local enterprises. Enterprises with high carbon emissions, such as Midea Air Conditioners and Ford Motor, coordinate with upstream and downstream supply chains to invest in reducing emissions. Therefore, some scholars have used the Stackelberg game model and evolutionary game theory to analyze and study the supply chain emission reduction strategy and efficiency against the government's carbon cap policy under the consideration of consumers' low-carbon preference.

Lou et al. [30] studied the coordination mechanism of revenue-sharing contracts under the influence of consumers' low-carbon preference. Based on Lou's research [30], Ghosh and Shah [31] and Swami and Shah [32] extended and analyzed the two pricing contracts, showing that both revenue-sharing contracts and pricing contracts can achieve supply chain coordination under consumers' low-carbon preference. Zhou [33] constructed a cost-sharing contract model by constructing a differential game model and using the Hamilton-Jacobi-Bellman equation to study the impact of low-carbon emission reduction input, publicity input, and publicity sharing rate on the performance of the dual-channel supply chain under centralized decision-making and Stackelberg games.

On the premise that enterprises voluntarily reduce emissions and consumers have a preference for low-carbon products, Wang and Zhao [34] used the Rubinstein bargaining model and revenue-sharing contract to study the impact of low-carbon coordination between individual manufacturers and retailers on low-carbon products. They studied the impact of manufacturers' carbon emission reduction efforts and cultivation of consumers' low-carbon awareness on low-carbon supply chain coordination and efficiency improvement.

Numerous studies have shown that the popularity of consumers' green and low-carbon awareness is almost a decisive factor for whether manufacturers or suppliers provide low-carbon products or how hard they try to provide low-carbon products. Chitra [35] indicated that the stronger the consumer's health and environmental awareness is, the higher the expected price they are willing to pay for green and low-carbon products. Vanclay et al. [36] studied the sales data of Australian products and found that the sales volume of low-carbon products was significantly higher than that of high-carbon products. Wei et al. [37] focused on the factors affecting consumers' low-carbon consumption, providing direction and reference for enterprises to promote or for the government to guide consumers' low-carbon consumption.

Furthermore, Liu et al. [38] considered consumers' green preference and analyzed the decision-making and profits of supply chain manufacturers and retailers. Many of the above-mentioned scholars have studied the impact of consumers' low-carbon preference on the decision-making of various entities in the supply chain, and some scholars have conducted comprehensive and systematic analysis and research on these impacts. Luo et al. [39] constructed

a two-stage game between manufacturers and retailers based on centralized decision-making and explored the impact of market carbon caps, consumer carbon sensitivity coefficients, and carbon emission reduction cost factors on the emission reduction efforts of supply chain members. Zhou [33] constructed a dual-channel centralized decision-making and a Stockberg decentralized decision-making model under the framework of low-carbon emission reduction-low-carbon product promotion-brand strategy analysis when there are product differences between different enterprises and promotion of low-carbon competition. They studied the response strategies of low-carbon emission reduction and publicity of supply chain members and designed the optimal cooperation mechanism.

3.2.2 Indirect impact

With the continuous improvement of productivity, natural resources have been overutilized to the point of exhaustion. Therefore, in order to improve resource utilization and reduce environmental pollution, countries such as the United States, Japan, and China have proposed the 3R (Reduce, Reuse, Recycle) system, to which China has added remanufacturing and further launched the 4R system [40].

In response to consumers' low-carbon preference, many manufacturers and retailers in the supply chain have chosen to build a closed-loop supply chain through product repurchase and other measures to achieve the purpose of reducing carbon emissions and utilizing resources efficiently by remanufacturing products. To realize product repurchase and remanufacturing, Ma et al. [41] studied the impact of government subsidy behavior on the pricing decision of dual-channel closed-loop supply chain when consumers have a low-carbon preference for dual channels. Roy et al. [40] explored and analyzed the impact of carbon consumers' acceptance of remanufactured products and carbon trading prices on corporate recycling, carbon emission reduction, and pricing decisions based on consumers' different demand preferences for remanufactured products and new products.

Roy et al. [42] constructed an economic optimization model of a two-stage duopoly market composed of brand manufacturers and remanufacturers, and found and proved that there is a unique pure strategy Nash equilibrium in the price yield of both sides. Peng et al. [43] introduced a third-party manufacturer and recovery function based on Pranab and studied the pricing strategy optimization of manufacturers' new and remanufactured products in this situation.

Considering that retailers or third parties need to obtain patent authorization from manufacturers to engage in remanufacturing, scholars have paid attention to research on remanufacturing patent licensing. Huang and Wang [44] compared the recycling strategies of the closed-loop supply chain under the three recycling and remanufacturing modes under the background of patent protection, and Hong's research [45] on three recycling channels. Hong et al. [45] studied the impact of different patent licensing strategies on closed-loop supply chain pricing and recycling decisions. Cao et al. [46] constructed a two-stage closed-loop supply chain model to analyze the impact of consumers' attention to remanufacturing on optimal decision-making. Zhao et al. [47] studied the pricing and recycling decisions of manufacturers' remanufacturing and retailers' remanufacturing in the closed-loop supply chain under different patent licensing strategies. On the basis of these studies, Zheng et al. [15] and others innovatively proposed the idea of remanufacturing products by authorizing third-party remanufacturing patents and studied a dual-channel closed-loop supply chain model based on this.

The advent of remanufactured products has also raised new questions about consumers' different opinions and preferences for these remanufactured products and new products. Guide Jr and Li [48] found that this difference in preferences will have a greater impact on the decision of recycled product manufacturers on recycled and remanufactured products. Guo et al. [49] modeled this preference as the inconsistency of consumers' willingness to pay for new products and remanufactured products (WTP) and studied the pricing and coordination mechanism of new products and remanufactured products in the market. Ferrer and Swaminathan [50] studied the pricing decision-making and coordination mechanism of single-cycle, dual-cycle, and multi-cycle remanufacturing systems based on consumers' preference for new products and remanufactured products, promoting the development of green manufacturing under the internet and meeting consumers' green and low-carbon consumption needs.

The above literature provides guidance and suggestions for manufacturers' production and reproduction, how the government influences consumers' low-carbon preference decision-making, and also provides models and directions for further research by subsequent scholars in this regard.

4 Conclusions

The dual-channel low-carbon supply chain has emerged as the main mode of current enterprises for sales, and it is also the mainstream trend in the future. This innovative approach not only improves the efficiency of the supply chain and system profits, and brings convenience to consumers, but also greatly improves the utilization of resources, which is a big step forward in the direction of sustainable green development.

Numerous scholars have studied the impact of consumers' low-carbon preference factors on supply chain pricing decisions and have proposed some profound and effective model schemes and suggestions. However, there are still deficiencies in some aspects that need to be addressed in future research.

Firstly, future studies may focus on consumers' low-carbon preference for different types of products, as the preferences of consumers for different product uses can vary. Moreover, influencing factors of consumers' low-carbon preference, such as the government's low-carbon policy, cultivation and publicity and promotion strategy, can be combined and considered comprehensively in the future.

Secondly, there is a lack of research that considers both consumers' low-carbon preference and the impact of "free-riding" behavior on dual-channel supply chain decisions. Future studies can explore whether the two behaviors have an internal connection or a certain linkage effect, and its impact on the dual-channel supply chain.

Thirdly, while most studies consider manufacturers, retailers, and consumers as the main members of the dual-channel supply chain, it is essential to include the influences of members such as the government and the media. Furthermore, as there are many dual-channel models, there will be an extremely complex multi-channel supply management system, so it is necessary to strengthen the study of complex dual-channel supply chains.

Fourthly, while the research theory of dual-channel supply chain under consumers' low-carbon preference has improved and enriched, there is a lack of empirical studies. Conducting relevant empirical research can help to transform theoretical value into real value, providing ideas and help for real cases.

In conclusion, while the existing literature provides valuable insights into the pricing decision-making of the dual-channel supply chain under consumers' low-carbon preference, there are still many opportunities for future research to address the gaps and advance the understanding of this topic. By exploring new variables, developing appropriate theoretical models, and conducting empirical research, we can enhance our knowledge of the dual-channel supply chain and facilitate the development of sustainable green development.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

[1] Z. Jiao, L. Ran, Y. Z. Zhang, Z. Q. Li, and W. S. Zhang, "Data-driven approaches to integrated closed-loop sustainable supply chain design under multi-uncertainties," *J. Clean Prod.*, vol. 185, pp. 105–127, 2018. https://doi.org/10.1016/j.jclepro.2018.02.255

[2] E. Sopadjieva, U. M. Dholakia, and B. Benjamin, "A study of 46,000 shoppers shows that omnichannel retailing works," *Harvard Bus. Rev.*, vol. 3, pp. 1–2, 2017.

[3] B. Berman, "Flatlined: Combatting the death of retail stores," *Bus. Horiz.*, vol. 62, no. 1, pp. 75–82, 2019. https://doi.org/10.1016/j.bushor.2018.08.006

[4] G. S. Cai, "Channel selection and coordination in dual-channel supply chains," *J. Retail.*, vol. 86, no. 1, pp. 22–36, 2010. https://doi.org/10.1016/j.jretai.2009.11.002

[5] Y. J. Ji, D. Q. Ma, and J. S. Hu, "Omni-channel operation strategy based on consumer behavior preference under vendor managed inventory," *Chin J. Manage. Sci.*, vol. 29, no. 1, pp. 82–86, 2021. https://doi.org/10.16381/j.cnki.issn1003-207x.2021.01.008

[6] J. Q. Yang, X. M. Zhang, H. Y. Fu, and C. Liu, "Inventory competition in a dual-channel supply chain with delivery lead time consideration," *Appl Math Model.*, vol. 42, pp. 675–692, 2017. https://doi.org/10.1016/j.apm.2016.10.050

[7] J. H. Zhou and R. J. Zhao, "Impact of free-riding on information disclosure strategies in dual-channel supply chains," *Sys. Eng. Theory Pract.*, no. 11, pp. 2839–2852, 2016.

[8] D. H. Xing and T. M. Liu, "Sales effort free riding and coordination with price match and channel rebate," *Eur. J. Oper. Res.*, vol. 219, no. 2, pp. 264–271, 2012. https://doi.org/10.1016/j.ejor.2011.11.029

[9] A. F. Zhang, Z. Z. Guan, and S. M. He, "Bi-channel optimal pricing and service level decision with two-way free rider," *Sys. Eng.*, vol. 37, no. 4, pp. 509–521, 2022.

[10] B. Wang, "Research on contract mechanism design for dual-channel low-carbon supply chain under different power structures," *Doctoral Dissertation, Zhejiang Gongshang University*, 2020.

[11] Q. Geng and S. M. Mallik, "Inventory competition and allocation in a multi-channel distribution system," *Eur. J. Oper. Res.*, vol. 182, no. 2, pp. 704–729, 2007. https://doi.org/10.1016/j.ejor.2006.08.041

[12] J. H. Chen, J. X. Mei, and J. J. Cao, "Decision making of hybrid recycling channels selection for closed-loop supply chain with dominant retailer," *Comput. Integr. Manuf. Syst*, vol. 27, pp. 954–964, 2021.

[13] M. Rayati, A. Sheikhi, A. M. Ranjbar, and W. Sun, "Optimal equilibrium selection of price-maker agents in performance-based regulation market," *J. Mod. Power Syst. Clean Energy*, vol. 10, no. 1, pp. 204–212, 2020. https://doi.org/10.35833/MPCE.2019.000559

[14] S. Saha, S. P. Sarmah, and I. Moon, "Dual channel closed-loop supply chain coordination with a reward-driven remanufacturing policy," *Int J. Prod. Res.*, vol. 54, no. 5, pp. 1503–1517, 2016. https://doi.org/10.1080/00207543.2015.1090031

[15] B. R. Zheng, J. Chu, and L. Jin, "Recycling channel selection and coordination in dual sales channel closed-loop supply chains," *Appl Math Model.*, vol. 95, pp. 484–502, 2021. https://doi.org/10.1016/j.apm.2021.02.022

[16] W. M. Ma, Z. Zhao, and H. Ke, "Dual-channel closed-loop supply chain with government consumption-subsidy," *Eur. J. Oper. Res.*, vol. 226, no. 2, pp. 221–227, 2013. https://doi.org/10.1016/j.ejor.2012.10.033

[17] L. Xiao, X. J. Wang, and K. S. Chin, "Trade-in strategies in retail channel and dual-channel closed-loop supply chain with remanufacturing," *Transp. Res. Part E: Logist Transp. Rev.*, vol. 136, p. 101898, 2020. https://doi.org/10.1016/j.tre.2020.101898

[18] Z. Y. Niu, "Analysis of pricing and coordination strategies in dual-channel closed-loop supply chain based on consumer channel preferences," *Master's Dissertation, Tianjin University of Technology*, vol. 2020, 2020.

[19] L. Gao, "Analysis of price difference between online channels and traditional channels based on online shopping psychology cost," *Master's Dissertation, Donghua University*, vol. 2015, 2015.

[20] C. R. Shen, Z. K. Xiong, and W. Yan, "Pricing and coordination research of dual-channel supply chain under price comparison," *Chin J. Manage. Sci.*, vol. 1, pp. 84–93, 2014.

[21] P. Xiao, "Research on channel selection behavior and dual-channel supply chain pricing considering decision inertia," *Master's Dissertation, Nanjing University*, vol. 2018, 2018.

[22] R. F. Wang, "Research on pricing strategies in dual-channel supply chains considering consumer channel preferences," *Master's Dissertation, Nanjing University*, vol. 2018, 2018.

[23] X. P. Hong, X. Y. Bai, and Y. Song, "Selection of product recycling channels based on extended todim method," *Exp. Sys. Appl.*, vol. 168, p. 114295, 2021. https://doi.org/10.1016/j.eswa.2020.114295

[24] C. L. Li, D. X. Fan, and X. L. Wang, "Contract design of 'online to offline' for dual-channel supply chain under bidirectional fairness concerns," *Chin J. Manage Sci.*, vol. 2018, no. 11, pp. 122–133, 2021.

[25] X. Liang and Y. T. Zhang, "Dual-channel supply chain pricing decision and emission reduction policies based on consumer preference to low carbon," *Oper. Res. Manag. Sci.*, vol. 29, no. 12, pp. 107–117, 2020.

[26] W. H. Wang and J. S. Hu, "Study of dynamic pricing and service decision in supply chain integrating online and offline channel," *Oper. Res. Manag. Sci.*, vol. 30, no. 12, pp. 84–91, 2021.

[27] Z. G. Liu, T. D. Anderson, and J. M. Cruz, "Consumer environmental awareness and competition in two-stage supply chains," *Eur. J. Oper. Res.*, vol. 218, no. 3, pp. 602–613, 2012. https://doi.org/10.1016/j.ejor.2011.11.027

[28] E. L. Plambeck, "Reducing greenhouse gas emissions through operations and supply chain management," *Energy Econ.*, vol. 34, pp. S64–S74, 2012. https://doi.org/10.1016/j.eneco.2012.08.031

[29] J. Chen, "Study on supply chain management in a low-carbon era," *J. Sys. Manage.*, vol. 21, no. 6, pp. 721–728, 2012. http://dx.chinadoi.cn/10.3969/j.issn.1005-2542.2012.06.002

[30] G. X. Lou, H. Y. Xia, J. Q. Zhang, and T. J. Fan, "Investment strategy of emission-reduction technology in a supply chain," *Sustain.*, vol. 7, no. 8, pp. 10 684–10 708, 2015. https://doi.org/10.3390/su70810684

[31] D. Ghosh and J. Shah, "A comparative analysis of greening policies across supply chain structures," *Int J. Prod Econ.*, vol. 135, no. 2, pp. 568–583, 2012. https://doi.org/10.1016/j.ijpe.2011.05.027

[32] S. Swami and J. Shah, "Channel coordination in green supply chain management," *J. Oper Res. Soc.*, vol. 64, no. 3, pp. 336–351, 2013. https://doi.org/10.1057/jors.2012.44

[33] X. D. Zhou, "Strategy on low carbon emission reduction, promotion in dual channel supply chain considering brand differentiation," *Oper. Res. Manag. Sci.*, vol. 26, no. 11, p. 93, 2017. http://dx.chinadoi.cn/10.12005/orms.2017.0265

[34] Q. P. Wang and D. Z. Zhao, "Revenue-sharing contract of supply chain based on consumer's preference for low carbon products," *Chin J. Manage Sci.*, vol. 22, no. 9, pp. 106–113, 2014.

[35] K. Chitra, "In search of the green consumers: A perceptual study." *J. Serv. Res.*, vol. 7, no. 1, 2007.

[36] J. K. Vanclay, J. Shortiss, S. Aulsebrook, A. M. Gillespie, B. C. Howell, R. Johanni, M. J. Maher, K. M. Mitchell, M. D. Stewart, and J. Yates, "Customer response to carbon labelling of groceries," *J. Consum. Policy*, vol. 34, no. 1, pp. 153–160, 2011. https://doi.org/10.1007/s10603-010-9140-7

[37] Y. M. Wei, L. C. Liu, Y. Fan, and G. Wu, "The impact of lifestyle on energy use and co2 emission: An empirical analysis of china's residents," *Energy Policy*, vol. 35, no. 1, pp. 247–257, 2007. https://doi.org/10.1016/j.enpol.2005.11.020

[38] Z. M. Liu, X. Li, X. R. Peng, and S. Lee, "Green or nongreen innovation? different strategic preferences among subsidized enterprises with different ownership types," *J. Clean. Prod.*, vol. 245, p. 118786, 2020. https://doi.org/10.1016/j.jclepro.2019.118786

[39] R. L. Luo, T. J. Fan, and H. Xia, "The game analysis of carbon reduction technology investment on supply

chain under carbon cap-and-trade rules," *Chin J. Manage Sci.*, vol. 22, no. 11, pp. 44–53, 2014.

[40] J. Y. Sun, L. Yang, and F. M. Yao, "Recovery and patent authorization strategy for closed-loop supply chain considering low carbon preference and carbon emission reduction," *Oper. Res. Manag. Sci.*, vol. 31, no. 9, pp. 120–127, 2022.

[41] W. M. Ma, Z. Zhao, and H. Ke, "Dual-channel closed-loop supply chain with government consumption-subsidy," *Eur. J. Oper. Res.*, vol. 226, no. 2, pp. 221–227, 2013. https://doi.org/10.1016/j.ejor.2012.10.033

[42] S. Roy, N. Modak, and P. K. Dan, "Product quality as factors and measures for new product development success in indian manufacturing industries," *Mat. Today: Pro.*, vol. 4, no. 2, pp. 1385–1393, 2017. https://doi.org/10.1016/j.matpr.2017.01.160

[43] Q. Y. Peng, C. X. Wang, and M. Goh, "Green financing strategies in a low-carbon e-commerce supply chain under service quality regulation," *Environ Sci. Pollut. Res.*, vol. 30, no. 2, pp. 2575–2596, 2023. https://doi.org/10.1007/s11356-022-22329-w

[44] Y. T. Huang and Z. J. Wang, "Closed-loop supply chain models with product take-back and hybrid remanufacturing under technology licensing," *J. Clean Prod.*, vol. 142, pp. 3917–3927, 2017. https://doi.org/10.1016/j.jclepro.2016.10.065

[45] X. P. Hong, K. Govindan, L. Xu, and P. Du, "Quantity and collection decisions in a closed-loop supply chain with technology licensing," *Eur. J. Oper. Res.*, vol. 256, no. 3, pp. 820–829, 2017. https://doi.org/10.1016/j.ejor.2016.06.051

[46] X. G. Cao, X. J. Wang, and H. Wen, "Managing new and remanufactured products with remanufacturing degree under patent protection," *Kybernetes*, vol. 49, no. 3, pp. 707–731, 2020. https://doi.org/10.1108/K-10-2018-0541

[47] J. J. Zhao, C. X. Wang, and L. Xu, "Decision for pricing, service, and recycling of closed-loop supply chains considering different remanufacturing roles and technology authorizations," *Comput. Ind Eng.*, vol. 132, pp. 59–73, 2019. https://doi.org/10.1016/j.cie.2019.04.019

[48] V. D. R. Guide Jr. and J. Y. Li, "The potential for cannibalization of new products sales by remanufactured products," *Decis Sci.*, vol. 41, no. 3, pp. 547–572, 2010. https://doi.org/10.1111/j.1540-5915.2010.00280.x

[49] J. H. Guo, G. Y. Li, and M. Ni, "The recovery mode selection of remanufacturing closed-loop supply chain under wtp difference," *J. Manag.*, vol. 12, no. 1, pp. 142–147, 2015.

[50] G. Ferrer and J. M. Swaminathan, "Managing new and differentiated remanufactured products," *Eur. J. Oper. Res.*, vol. 203, no. 2, pp. 370–379, 2010. https://doi.org/10.1016/j.ejor.2009.08.007