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A Literature Review on Closed-Loop Oil Supply Chain Pricing

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Abstract

Taking the closed-loop oil supply chain as the research object, this paper systematically reviews the research progress of the pricing strategy of the closed-loop supply chain from four dimensions: channel competition, power structure, government intervention and carbon emissions trading. In terms of channel competition, the influence of online and offline integration mode on pricing decisions is discussed, and it is pointed out that multi-channel competition needs to be optimized in combination with cost, market demand and synergy. The analysis of power structure shows that there are significant differences in the pricing strategies under the manufacturer-led, retailer-led and third-party recycler-led models, and the interests of all parties need to be balanced through the game model. Government intervention mechanisms directly affect the environmental protection costs and pricing space of enterprises through regulations, subsidies and carbon trading policies, while the carbon emissions trading system promotes the application of low-carbon technologies through carbon allowance allocation and market price fluctuations. The study points out that in the future, it is necessary to pay attention to the interaction of multiple factors, the impact of new technologies and international cooperation to achieve the refined management and sustainable development of the oil supply chain.

Keywords

Closed-loop Oil Supply Chain; Pricing Strategy; Channel Competition; Government Intervention; Carbon Emissions Trading.

1. Introduction

In the field of management science, supply chain pricing decisions have always been a core research topic. With the continuous evolution of market environments and the refinement and diversification of consumer demands, enterprises face the challenge of effectively managing supply chain pricing to maximize profits, meet consumer needs, and enhance overall supply chain efficiency. Amid rapid global economic development and increasingly severe environmental issues, closed-loop supply chain management has emerged as a critical research frontier. Particularly in petroleum supply chains, pricing decisions not only impact corporate profitability but also directly affect resource utilization efficiency and environmental sustainability. This paper reviews closed-loop supply chain pricing strategies from four dimensions-channel competition, power structures, government interventions, and carbon emissions trading-to provide decision-making references for petroleum supply chain pricing. The petroleum supply chain is inherently complex, focusing on oil production and distribution, requiring meticulous management to ensure operational efficiency. Its sensitivity to government policies further underscores its unique challenges and systemic adaptability [1].

2. Channel Competition and Closed-Loop Supply Chain Pricing

The rise of e-commerce and third-party logistics has driven manufacturers to increasingly rely on online direct sales. Direct sales enable manufacturers to directly engage with consumers,

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uncover latent demands, expand markets, and achieve precise customer targeting. Additionally, direct sales transform manufacturers into formidable competitors in the retail market. While online platforms offer convenience, product variety, and flexible shopping times, traditional channels retain advantages such as lower shopping risks and immediate product inspection. Thus, manufacturers must integrate online and offline strategies to balance consumer preferences and enhance competitiveness [2].

In petroleum supply chains, competition between direct sales and retail channels is intense. Direct sales excel in price responsiveness, while retail channels leverage extensive coverage and customer relationships. Research by Savaskan et al. compared recycling methods in monopolistic supply chains, revealing their profit implications [3]. With the advent of "new retail" and "Internet+" models, hybrid online-offline sales and recycling strategies have gained traction. For instance, Yan Yanchao and Ma Zujun explored "online sales/recycling + offline service" models under revenue-sharing mechanisms [4]. Guo Junhua proposed a dual-channel model ("retail + time-share leasing") for electric vehicles [5], while Zhu Chen and Zhang Jixiang examined closed-loop supply chains with quality-differentiated recycled products under retailer dominance using Stackelberg game theory [6]. In summary, multi-channel competition and online and offline integration have become a new trend in closed-loop supply chain research, which is helpful for a more comprehensive understanding and optimization of supply chain operation strategies [7].Key innovations in this field include:

2.1. Multichannel Competition Models

With the rise of e-commerce and "new retail", the traditional single-channel model can no longer meet market demand. These publications begin to explore the impact of multi-channel competition on closed-loop supply chains, such as the dual-channel operation model of "retail time-share leasing" and the combination of online and offline channels. The study of this multi-channel model can help enterprises better understand and respond to market changes, optimize resource allocation, and enhance competitiveness.

2.2. Recycled Product Quality Differentiation

In closed-loop supply chains, there are often differences in the quality of recycled products. Zhu Chen and Zhang's literature innovatively considers this factor and establishes a closed-loop supply chain model that includes manufacturers, retailers, and third parties. This model, which takes into account the differences in the quality of recycled products, is more realistic and can help companies develop more accurate pricing and recycling strategies.

2.3. Stackelberg Game Applications

Under the premise of retailer leadership, it is a new research method to use Stackelberg to find the optimal price and profit of supply chain members under centralized and decentralized decision-making. This method helps to reveal the game relationship between supply chain members and provides a reference for enterprises to make decisions.

2.4. Integration of "Internet+" and "New Retail"

These papers combine the ideas of "Internet" and "new retail" with the study of closed-loop supply chains, and explore the sales and recycling models of online and offline integration. This combination not only broadens the research horizon of closed-loop supply chain, but also provides new development ideas for enterprises.

Considering the profits of supply chain members and consumer demand: When studying closed-loop supply chains, these literatures not only focus on maximizing the profits of supply chain members, but also consider the needs of consumers. For example, by optimizing channel selection, pricing and recycling strategies, it aims to achieve a win-win situation for supply chain members' profits and consumer satisfaction.

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In summary, these literatures have significant innovations in the field of closed-loop supply chain research, and provide valuable reference and enlightenment for enterprises. In the study of closed-loop supply chain, Chen et al. established single-channel and dual-channel sales models, and explored the impact of parameter changes on pricing, revenue and recovery efficiency. However, the seller-led or tripartite recycling scenario has not yet been addressed, and these extended studies will provide more comprehensive insights [8]; Researchers Yao Xuexiang considered random demand and dual-channel recycling, invested in advertising in sales and recycling, and discussed the impact of advertising investment on product price and profit.They found that a reasonable advertising strategy can help increase product awareness, optimize pricing strategies, and ultimately increase the profits of each member of the closed-loop supply chain [9]. Zheng et al. integrated product recycling and sales strategies in a closed-loop supply chain, and analyzed the impact of different recycling modes on manufacturers' channel choices, so as to deepen the understanding of the importance of recycling strategies [10]. Xu Lang et al. built a closed-loop supply chain model composed of manufacturers and retailers, taking into account the competition of recycling channels. Using Stackelberg game theory, they compare the pricing and recovery strategies of remanufactured products under centralized and decentralized decision-making, and propose a cost-benefit sharing contract based on the Nash negotiation principle to improve overall performance and achieve Pareto improvement. Such contracts can help optimize the operational efficiency and benefits of closed-loop supply chains [11];When Ni Ming et al. deeply explored the closed-loop supply chain mechanism of recycling and remanufacturing of waste electronic products in the context of uncertain demand, this paper focused on the actual situation of dual-channel recycling in the current market environment. By carefully constructing three differentiated models of dual-channel recycling models, this study carefully analyzes how the competition coefficient between dual-channel recycling channels has a specific impact on the optimal decision-making. Through this comprehensive and in-depth analysis, we can more accurately understand the optimal operation strategy of the closed-loop supply chain for the recycling and remanufacturing of waste electronic products in the complex environment of uncertain demand and the coexistence of dual-channel recycling, and provide more practical and effective decision-making support for relevant enterprises [12]; Zhu Xiaodong et al. constructed a closed-loop supply chain model involving multiple participants. The model encompasses the three core elements of manufacturers, distributors and online recyclers.Manufacturers are responsible for the production of products, distributors are responsible for getting products to the end consumer, and online recyclers collect and dispose of waste products through online platforms, providing important recycling services throughout the closed-loop supply chain. This model is designed to optimize the use of resources, reduce environmental pollution, and achieve sustainable development. In particular, this paper focuses on the difference between online recyclers and distributors in terms of recycling costs, and on this basis, this paper studies the recycling pricing strategy of waste products and the profit contract coordination of all parties under two different decision-making mechanisms: centralized and decentralized. Through this research, it is expected to provide useful insights and strategic suggestions for the optimal management of closed-loop supply chains [13]. Wang et al. focus on the impact of government subsidies and carbon emission caps on closed-loop supply chains, especially for manufacturers' recycling activities.By establishing a three-stage game model of a closed-loop supply chain that includes dual-channel sales and recycling, we explore in depth how the government can determine the optimal subsidy strategy based on the principle of maximizing social welfare under different carbon emission limit policies. By comparing and analyzing whether there is a carbon emission limit or not, we reveal how the carbon emission cap and carbon emission ratio affect the decision-making results, which provides a valuable reference

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for the government to formulate relevant policies and adjust the supply chain strategy of enterprises [14].

In a closed-loop supply chain pricing strategy, companies need to consider the cost, market demand, and competitive situation of different channels. For example, when the cost of the direct sales channel is low, businesses can adopt a low-price strategy to attract consumers, while leveraging the retail channel for branding and after-sales service. In addition, enterprises can also achieve complementary advantages between channels and enhance overall competitiveness through channel collaboration and resource integration.

3. Power Structures and Closed-Loop Supply Chain Pricing

Channel power describes the ability of a channel member to exert control and influence over the behavior of other members in a closed-loop supply chain. This power structure reflects the relative differences in the position of different companies in the supply chain. Traditionally, strong manufacturing companies tend to dominate as market leaders, while distributors and retailers are relatively passive followers. However, as the market environment has changed, the power structure in the closed-loop supply chain has changed significantly. Currently, common power structures include producer-led, retailer-led, and third-party recyclers.

In the case of manufacturer-led, enterprises have strong bargaining power and resource integration ability, and can formulate more flexible pricing strategies. For example, manufacturers can guide consumers to choose environmentally friendly products by adjusting the price of remanufactured products; At the same time, by recycling waste products, production costs are reduced and resource recycling is realized.

In the case of retailer dominance, retailers have strong market influence and consumer stickiness. Retailers can achieve a win-win situation by working with manufacturers to develop pricing strategies. In addition, retailers can engage consumers and enhance brand value by offering personalized services and experiences.

In the case of third-party recyclers, recyclers have a professional advantage in the recycling and disposal of waste products. Enterprises can cooperate with recyclers to achieve effective recycling and resource utilization of waste products. In terms of pricing, companies need to consider factors such as recycling costs and environmental protection costs to formulate a reasonable pricing strategy.

In order to explore the performance of supply chains under different power structures, Zheng et al. constructed the Stackelberg and Stackelberg-Nash models of manufacturer-led and retailer-led respectively, and studied the impact of manufacturers' acquisition strategies on supply chain members and the whole. In particular, they analyzed how the degree of channel competition affects supply chain decisions under different channel structures under the conditions of symmetric and asymmetric initial demand [15].Zhang et al. further constructed a closed-loop supply chain model composed of manufacturers and retailers, and explored the performance of manufacturers and retailers when they are responsible for recycling under two different channel power structures: manufacturer leaders and retailer leaders. By comparing these four different closed-loop supply chain models, they analyzed the differences between these models in terms of environmental performance and economic performance [16].These studies provide a new perspective for understanding power structures and their impacts in closed-loop supply chains; Yao et al. studied the impact of corporate social responsibility (CSR) behavior on closed-loop supply chain pricing under different channel power structures, and established six pricing models considering CSR and channel power [17]. Wen Hui et al. constructed four decision-making models in a dual-channel environment. These models cover three decentralized decision-making scenarios, including manufacturer-led, retailer-led, and Nash equilibrium games, as well as a centralized decision-making model. Through these models,

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we analyze in detail the pricing and coordination strategies in the closed-loop supply chain under different channel power structures, and derive the corresponding equilibrium strategies [18].Liu Wenjie and other scholars have also constructed a three-level closed-loop supply chain model for remanufacturing, which comprehensively considers multiple links such as manufacturing/remanufacturing, retailers, consumers, and recyclers. Using Stackelberg game theory, they delved into the optimal pricing strategies under different channel power structures, and paid special attention to the impact of waste product recovery rate and product substitution coefficient on decision-making. In order to verify the effectiveness of the model, they applied the model to the actual case of automobile generator remanufacturing [19];Liu Shan and other scholars focused on the CSR (Corporate Social Responsibility) sharing mechanism and pricing strategy of enterprises in the closed-loop supply chain. Under the framework of the Stackelberg and Nash games, they studied how CSR is shared among members of the closed-loop supply chain, and analyzed the potential impact of CSR behavior on new product pricing and waste product recycling. These studies provide new perspectives and insights into our understanding of power structures, pricing strategies, and corporate social responsibility in closed-loop supply chains [20].

4. Government Interventions and Closed-Loop Supply Chain Pricing

Government institutional intervention plays a crucial role in the pricing of closed-loop supply chains. The government guides and regulates all aspects of the supply chain by formulating relevant policies and regulations to promote the efficient use of resources and the sustainable development of the environment.

Laws and regulations: The government requires enterprises to adopt environmental protection policies to reduce carbon emissions and environmental pollution by formulating strict environmental protection regulations and standards. These regulations and standards have an impact on the production costs and market competitiveness of enterprises, which in turn affects their pricing strategies.

Fiscal subsidies and tax incentives: To encourage businesses to adopt an environmentally friendly and sustainable development model, the government often provides incentives such as fiscal subsidies and tax incentives. These measures can reduce the production costs and risks of enterprises, encourage them to increase environmental investment, and then develop more reasonable pricing strategies.

Regulation and penalties: The government will also impose restrictions and sanctions on companies that do not meet environmental requirements through regulation and penalties. These measures can force companies to take environmentally friendly measures to reduce carbon emissions and environmental pollution, and then consider environmental costs in their pricing strategies.

In the oil supply chain, the government can ensure the rational use of resources and the protection of the environment by regulating and regulating the extraction, refining and sales of crude oil. At the same time, the government can also encourage enterprises to carry out waste oil recycling and reuse business to reduce environmental pollution and resource waste.

In terms of pricing, the government can influence the cost structure and market behavior of enterprises by adjusting tax and subsidy policies. For example, the government can give tax incentives and financial subsidies to environmentally friendly products to reduce the production costs and market risks of enterprises; At the same time, high taxes and fines are levied on heavily polluting products to promote the development of enterprises in the direction of environmental protection and sustainability.

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5. Carbon Emissions Trading and Closed-Loop Supply Chain Pricing

As a new type of environmental protection policy tool, carbon emissions trading has a profound impact on the pricing of closed-loop supply chains. Emissions trading encourages companies to reduce carbon emissions and improve resource efficiency by setting carbon caps and allowing carbon emissions trading.

Cost of carbon emissions: Under the ETS, companies are required to pay a corresponding cost for the carbon they emit. This will directly affect the company's production cost and market competitiveness, which in turn will affect its pricing strategy. Companies consider factors such as their own carbon emission costs, market demand, and competitive situation to formulate reasonable pricing strategies.

5.1. Carbon Quota Allocation

The government allocates corresponding carbon allowances according to the production scale and emissions of enterprises. Enterprises need to buy or sell carbon allowances on the carbon trading market to meet their production needs. This will affect the carbon costs and pricing strategies of companies. If the carbon allowance is low, its carbon cost will increase, and it may need to make up for the cost by raising the price of the product; Conversely, if a company receives a higher carbon allowance, its carbon cost will be lower, and it can gain more flexibility in pricing.

5.2. Carbon Market Price

Price fluctuations in the carbon trading market will also affect the pricing strategy of enterprises. When the carbon market price is high, enterprises need to pay more carbon costs, and may choose to increase the price of products or reduce production; When the carbon market price is low, companies can reduce the cost of carbon and thus gain a greater advantage in pricing.

In the oil supply chain, the implementation of carbon emissions trading policies will directly affect the production costs and market competitiveness of enterprises. Enterprises need to comprehensively consider factors such as carbon emission costs, market demand, and competitive dynamics to formulate a reasonable pricing strategy. For example, companies can reduce the cost of carbon emissions by adopting low-carbon technologies and optimizing production processes. At the same time, it responds to changes in market competition and consumer demand by adjusting product prices and marketing strategies.

6. Conclusion and Prospects

This paper reviews the pricing strategies of closed-loop supply chain from four dimensions: channel competition, different power structures, government mechanism intervention and carbon emissions trading. By comparing and analyzing the pricing strategies and influencing factors under different scenarios, it provides a decision-making reference for the pricing of the oil supply chain. Future research can further explore the problem of closed-loop supply chain pricing under the interaction of multiple factors, as well as the impact of new technologies and models on closed-loop supply chain pricing. At the same time, it is also necessary to strengthen international cooperation and policy coordination to jointly promote the sustainable development of global supply chains. In the face of the macro trend of volatile crude oil prices, the oil supply chain must continue to be refined and optimized to ensure optimal operation.

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