Hindawi
Mathematical Problems in Engineering
Volume 2023, Article ID 9818473, 1 page
https://doi.org/10.1155/2023/9818473

Retraction

Retracted: Analysis on the Water Supply Chain Model under Revenue-Sharing Contract considering Marketing Effort, Water Purity

Mathematical Problems in Engineering

Received 18 July 2023; Accepted 18 July 2023; Published 19 July 2023

Copyright © 2023 Mathematical Problems in Engineering. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] L. Huang and D. Tang, "Analysis on the Water Supply Chain Model under Revenue-Sharing Contract considering Marketing Effort, Water Purity," *Mathematical Problems in Engineering*, vol. 2021, Article ID 5593463, 23 pages, 2021.

Hindawi
Mathematical Problems in Engineering
Volume 2021, Article ID 5593463, 23 pages
https://doi.org/10.1155/2021/5593463

Research Article

Analysis on the Water Supply Chain Model under Revenue-Sharing Contract considering Marketing Effort, Water Purity

Lijia Huang[1] **and Deshan Tang**[1,2]

[1]*Business School, Hohai University, Nanjing 211100, Jiangsu, China*
[2]*College of Water Conservancy and Hydropower Engineering, Hohai University, Nanjing 210098, Jiangsu, China*

Correspondence should be addressed to Lijia Huang; huanglijia@hhu.edu.cn

Received 5 February 2021; Revised 10 March 2021; Accepted 25 March 2021; Published 13 April 2021

Academic Editor: Sang-Bing Tsai

Copyright © 2021 Lijia Huang and Deshan Tang. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

A two-tier water supply chain including a manufacturer and a retailer under revenue-sharing contract is constructed. And the contribution of the model is that marketing effort and water purity has been considered. First, four models including the centralized model (model B) and decentralized models (models BM, I, and II) are established and analyzed. Second, the Stackelberg game model is used to discuss the pricing strategy of water supply chain members in centralized and decentralized scenarios. The comparison results show that revenue-sharing contract is beneficial to improve the level of product greening, the profit of supply chain members, and the overall profit of the water supply chain compared with model BM. However, it leads to the decrease of retailers' green marketing efforts and the wholesale price of water. In addition, revenue-sharing contract through bargaining makes bigger influence than revenue-sharing contract. Marketing can stimulate the increase of the green product's market demand on one hand, and on the other hand, it generates the amount of marketing cost. In this study, the profit is that marketing produces cannot offset the cost that it brings. Thus, it will be important to take some measures to make up the loss that marketing generated.

RETRACTED

1. Introduction

As the blood of the earth, the source of life, and the cradle of civilization, water has important resource function, ecological function, and economic function. Due to the scarcity of water resources and the discharge of a larger number of domestic sewage and industrial wastewater, the manufacturing process of drinking water is critical. With the modern day acceleration of industrialization and urbanization, the demand for water increased rapidly. Moreover, water pollution incidents that happened occasionally also had promoted the demand for water, especially clean water. Nowadays, plenty of enterprises such as NONGFU SPRING, China's drinking water industry benchmarking enterprise, is focusing on research and development and promotion of mineral water.

Recently, low-carbon life is a hot topic, and a lot of companies are devoting themselves to green products. Also, consumers are shifting their preferences to more environment friendly brands. The green brand image and green brand value can be transformed into the customer's brand loyalty when customers have the concept of green consumption [1]. Therefore, retailers end up going green marketing [2].

Collaboration between partners is beneficial to bring both environment and economy improvement to water supply partners [3]. To motivate water supply chain member's cooperation, it is a common practice in the world that leading enterprises propose a series of green manufacturing requirements, including energy conservation, environmental protection, energy efficiency, and environmental emission, in the procurement process [4]. Only

the water suppliers who meet the requirements can become the suppliers of brand enterprises. In addition, in the financial sector, green finance is used to guide funds to green industries to control and reduce pollution-related investment, so as to promote green production in the whole society.

In this study, two-tier water supply chain models under different Stackelberg scenarios are introduced. Revenue-sharing contract is studied by considering both water marketing effort and water purity. Thus, several questions should be addressed. (1) How do water supply chain members' decisions and profitability are impacted when considering water purity and marketing efforts under revenue-sharing contracts? (2) What are the optimal decision strategies for water supply chain members under different scenarios? Therefore, our study has the following contributes.

(1) Water supply chain models under both centralized scenario and decentralized scenario are constructed. Decision-strategy for supply chain members is analyzed and compared in different models.

(2) Under decentralized scenario, the imparts of revenue-sharing contract on different members and the whole supply chain have been analyzed

There are 4 sections concluded in this study. The 2nd section introduces the previous researchers. In Section 3, models of water supply chain considering water purity and marketing effort are studied. Section 4 presents numerical analysis. We summarize the research and come up with management insights in Section 5.

2. Literature Review

Water supply chain has been studied academically for decades. Since about 2004, supply chains have been widely used in water management. As an instance, research [5] applied supply chain in water resources allocation and dispatch. In 2005, [6] built a hybrid agent-based model to estimate residential water demand by simulating the residential water supply chain. Research [7] demonstrated that the related supply chain management theory and methodology can be applied in water resources allocation and dispatching. The bullwhip effect was studied in the water resource supply chain information management by using stochastic control theory [8]. The optimization of water supply chain management was studied in literature [9], and they came up with a systematic engineering method to reduce the total water demand. In 2007, the study [10] established an optimal multiobjective model of water resource allocation. In 2008, the studies [11, 12] researched joint pricing of water on the basis of cooperative and noncooperative game theories in a two-tier water supply chain. Study [13] developed a spatial water distribution plan that can save cost and time. In 2010, Kogan and Tapiero [14] discussed the economic benefits of two-stage water supply chain by constructing a zero-sum stochastic differential game model. Elala et al. [15] talked about the safety of water supply chain and provided practical suggestions for communities, enterprises, and local authorities to realize water supply chain risk management. Zhou et al. [16] also discussed the water supply chain risk management experiences based on the case study in Sweden. Portable water supply chain from water collecting to water distribution by taking advantage of the theory of product life cycle chain has been studied in research [17]. In [18], water supply chain transformation has been discussed by constructing a multiperiod mixed integer program model, and they found that comprehensive integration of water supply chain networks and coordination of water production will bring economic and environmental benefits if they are considered within the planned time frame. For water supply-demand with uncertainty, the study [19] utilized the artificial neural network and stationary chain to predict water demand. In 2015, by updating the artificial fish swarm algorithm and the supply chain management theory, the problem of water resources scheduling was solved [20]. Water Data Warehouse (a software) was designed to share the water supply demand information in the whole water supply chain [21]. In [3], taking the reliability of water supply into consideration, they constructed a multiperiod-mixed integer linear programming model to achieve the water supply reliability maximization, and it was found that water demand has a huge effect on the reliability of water supply chain.

Water supply chain coordination is a branch of supply chain management. There are also many research studies on water supply chain coordination. For example, on the basis of communication and coordination and the principle-agent theory, water resource supply chain contract was constructed [5, 7]. Research [22] designed a multilevel, Pareto optimization decision-making model to deal with the multilevel cooperative decision-making problem of the South-to-North Water Transfer Project. In 2006, Dai et al. [23] established a decision-making model of supply chain agent under the contract effect by applying group gaming decision theory on the basis of water resources supply chain. A study [24] observed water inventory coordination by using inventory control theory and proposed transfer payment coordination strategy of water inventory management under VMI theory. In order to derive water resource, Kondili and Kaldellis [25] developed a decision support system (DSS) to coordinate the conflicts between customers' demand in water supply chain. In 2009, a research [14] analyzed the optimal, respectively, in the minimum commitment and flexibility contract based on a two-stage water supply chain. In 2012, a study [26] demonstrated the optimization modeling approach for the pricing and coordinating schemes of SNWD-ER project. Chen [27] considered the water suppliers' profitability and distributers' profitability under the perspective of social responsibility and economic benefit. In [28–33], the pricing strategies of a competitive two-tier water supply chain including one supplier and two distributers under two-part pricing contract and wholesale price contract was studied, and the findings reveal many practical management insights. In 2018, a study [3] investigated the decision-making strategies of water supply chain members by considering who played the leader and follower, and water resources management insights were

RETRACTED

provided. In 2019, water supply chain equilibrium and coordination were studied in [31]; in addition, fairness factors are considered to compare the supply chain performances, social welfare, and consumer surplus under different equilibrium strategies and coordination strategies. In 2020, literature [34] revealed that revenue and cost sharing contract could effectively coordinate and improve the water supply chain performance (Figure 1 and Table 1).

3. Model Description

3.1. Assumptions and Demand Function

(1) We assume that in the centralized decision-making system, the manufacturers determine the green marketing effort (e), while in the decentralized system, the retailers decide the green marketing effort. Based on [35–37], the total green marketing effort cost is ($\eta e^2/2$), where η stands for the marketing cost coefficient.

(2) In this study, the demand function is of retail price, green marketing effort, and demand. Retailers' investment is in green marketing in order to promote the green market, and the greater the marketing efforts, the greater the effect on demand.

(3) Manufacturers' green R&D mainly means that green manufacturing can use fewer resources to produce the same product and improve resource utilization rate. Water purity $\theta(0<\theta\leq 1)$ improvement indicates that manufactures should increase research and development costs, and we assume that all the costs were born by the manufacturers. Referring to [38], the R&D investment of manufacture is $\beta\theta^2$, where β means the cost rate of research and development.

(4) Parameter α represents the sensitivity of consumer to water purity improvement. The bigger the manufacturers invest in R&D, the more $\alpha\theta$ impact to demand.

(5) The parameters and their meanings used in this study are given in Table 1

(6) The manufacture purified ground water and the retailer buys it at wholesale price and sells it to the market at retail price (Figure 1). We consider that the actual demand of the market (q) is a linear function depending on retail price, green marketing effort, and water purity. The demand function is shown in the following equation.

$$q(p,e,\theta)=a-kp+\gamma e+\alpha\theta. \tag{1}$$

3.2. Stackelberg Equilibrium and Profitability Analysis

3.2.1. Profit Analysis under Centralized Decision Making (Model B). Centralized decision-making refers to a commodity produced and sold by the manufacturer, that is to say, a manufacturer integrates production and sales (vertical integration); more specifically, there is only one interest subject in the whole supply chain except customers, which is called integrated manufacturer. In the centralized model, we suppose that a central decision-maker is responsible for the retail price, the green marketing effort, and water purity.

The water supply chain's profit function is shown as

$$\Pi_{SC}^{B}=(p-c)(a-\mathrm{kp}+\gamma e+\alpha\theta)-\beta\theta^2-\frac{\eta e^2}{2}. \tag{2}$$

After solving the first-order derivative of Π_{SC}^{B} with respect to p, θ, and e, we get

$$\frac{\partial\Pi_{SC}^{B}}{\partial p}=a-2\mathrm{kp}+\gamma e+\alpha\theta+\mathrm{ck}, \tag{3}$$

$$\frac{\partial\Pi_{SC}^{B}}{\partial\theta}=\alpha p-c\alpha-2\beta\theta, \tag{4}$$

$$\frac{\partial\Pi_{SC}^{B}}{\partial e}=\gamma p-c\gamma-\eta e. \tag{5}$$

Afterwards, we set all the equations (3)–(5), all equal to zero to obtain equilibrium values of model B. The equilibrium values of the equation set are as follows:

$$p_{SC}^{*B}=-\frac{2\mathrm{ck}\beta\eta-c\left(\alpha^2\eta+2\gamma^2\beta\right)+2a\beta\eta}{\alpha^2\eta+2\gamma^2\beta-4k\eta\beta}, \tag{6}$$

$$\theta_{SC}^{*B}=\frac{kc\eta\alpha-\eta a\alpha}{\alpha^2\eta+2\gamma^2\beta-4k\eta\beta}, \tag{7}$$

$$e_{SC}^{*B}=\frac{2k\beta c\gamma-2\beta a\gamma}{\alpha^2\eta+2\gamma^2\beta-4k\eta\beta}. \tag{8}$$

Substitute (6)–(8) into functions (1) and (2) to get the optimal actual market demand (q_{SC}^{*B}) and the profit of supply chain (Π_{SC}^{*B}).

$$\begin{aligned} q_{SC}^{*B}&=\frac{2k^2\eta\beta c-2k\eta\beta a}{\alpha^2\eta+2\gamma^2\beta-4k\eta\beta},\\ \Pi_{SC}^{*B}&=\frac{2\beta\eta\mathrm{ack}-\beta\eta a^2-\beta\eta c^2k^2}{\alpha^2\eta+2\gamma^2\beta-4k\eta\beta}. \end{aligned} \tag{9}$$

Lemma 1. *If it satisfies the conditions that $\alpha^2-4k\beta<0$ and $\alpha^2\eta+2\gamma^2\beta-4\beta\eta k<0$, the Hessian matrix of the profit function of the centralized supply chain is negative definite matrix. There exists a maximum value in the point $(p^{*B},\theta^{*B},e^{*B})$, and the profit function of Π_{SC}^{B} is strictly concave in the retail price p, the green marketing effort e, and water purity θ.*

Proof (Appendix). □

Proposition 1. *The Stackelberg equilibrium of the centralized supply chain is*

RETRACTED

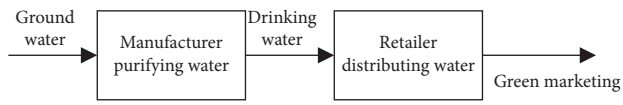

Figure 1: Two-tier water supply chain.

Table 1: Parameters and their meanings.

Parameter	Meaning
a	Total market potential and $a > 0$
q	Actual demand of the market
k	Price elasticity of demand and $k > 0$
e	The retailer's green marketing effort to promote the green product
γ	The impact of the marketing effort on demand
η	Marketing cost coefficient
$(\eta e^2/2)$	The total cost of the green marketing effort
c	The manufacturer's cost of purifying water
w	The wholesale price of products
p	The retail price of green products
θ	Water purity and $0 < \theta \leq 1$
α	The sensitivity of consumer to water purity improvement
β	The cost rate of research and development (R&D)
$\beta\theta^2$	The R&D investment of manufacture
φ	Revenue-sharing ratio

$$p_{\mathrm{SC}}^{*B} = -\frac{2\mathrm{ck}\beta\eta - c\left(\alpha^2\eta + 2\gamma^2\beta\right) + 2a\beta\eta}{\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta},$$
$$\theta_{\mathrm{SC}}^{*B} = \frac{kc\eta\alpha - \eta a\alpha}{\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta},$$
$$e_{\mathrm{SC}}^{*B} = \frac{2k\beta c\gamma - 2\beta a\gamma}{\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta}, \tag{10}$$
$$q_{\mathrm{SC}}^{*B} = \frac{2k^2\eta\beta c - 2k\eta\beta a}{\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta},$$
$$\Pi_{\mathrm{SC}}^{*B} = \frac{2\beta\eta\mathrm{ack} - \beta\eta a^2 - \beta\eta c^2k^2}{\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta}.$$

To ensure that all the equilibrium values are meaningful, the necessary condition is $kc - a < 0$ and $\gamma^2 - 2k\eta < 0$. Moreover, when $\beta^{*B} \geq ((\eta\alpha(kc - a - \alpha))/(\gamma^2 - 2k\eta))$, it guaranteed that $0 < \theta_{\mathrm{SC}}^{*B} \leq 1$.

Proof (Appendix). □

3.2.2. Profit Analysis under Decentralized Decision Making (Model BM). The decentralized decision-making game model means that the manufacturer and the retailer are two independent interest subjects to maximize their profit functions. In this study, we assume the Stackelberg game relationship between manufacturer and seller; manufacturer is the leader and decides the wholesale price and the greening degree of a product; the retailer is a follower who determines the retail price of the product and the level of the green marketing effort according to the manufacturer's decision. In this case, the profit function of the manufacturer and retailer is expressed as follows, respectively:

$$\Pi_R^{\mathrm{BM}} = (p - w)(a - \mathrm{kp} + \gamma e + \alpha\theta) - \frac{\eta e^2}{2}, \tag{11}$$

$$\Pi_M^{\mathrm{BM}} = (w - c)(a - \mathrm{kp} + \gamma e + \alpha\theta) - \beta\theta^2. \tag{12}$$

According to the backward algorithm, in the first stage, based on the anticipation of retailer's retail price and marketing effort, the manufacture sets the wholesale price and purity of drinking water. In the second stage, concerning the wholesale price and marketing effort, the retailer decides the retail price and marketing effort. According to the backward algorithm, the retail price and marketing effort are obtained through the first derivative of the retailer's profit function with respect to the retail price and marketing effort. Afterwards, substitute them into the profit function of the manufacturer to get its first derivative with respect to the wholesale price and water purity.

The first-derivative result of Π_R^B with respect to p and e is shown as

$$\frac{\partial\Pi_R^{\mathrm{BM}}}{\partial p} = a - kp - k(p - w) + \alpha\theta + \gamma e = 0,$$
$$\frac{\partial\Pi_R^{\mathrm{BM}}}{\partial e} = \gamma(p - w) - \eta e = 0. \tag{13}$$

Next, we can obtain the optimal retail price and marketing effort of the retailer as follows:

RETRACTED

$$p_R^{\mathrm{BM}} = -\frac{-w\gamma^2 + \eta a + \eta k w + \alpha\eta\theta}{\gamma^2 - 2\eta k}, \tag{14}$$

$$e_R^{\mathrm{BM}} = -\frac{\gamma(a - kw + \alpha\theta)}{\gamma^2 - 2\eta k}. \tag{15}$$

Put p_R^{BM} and e_R^{BM} into the profit function of manufacturer Π_M^{BM}. Then, we get

$$\Pi_M^{\mathrm{BM}} = \frac{-\beta\gamma^2\theta^2 + 2\beta\eta\theta^2 k - \alpha\eta\theta k w + \alpha\eta c\theta k + \eta k^2 w^2 - \eta a k w + \eta a c k}{\gamma^2 - 2\eta k}. \tag{16}$$

After taking the first derivative of Π_M^B with respect to w and θ, we get

$$\frac{\partial \Pi_M^{\mathrm{BM}}}{\partial w} = -\frac{\eta a k + \eta c k^2 - 2\eta k^2 w + \alpha\eta\theta k}{\gamma^2 - 2\eta k} = 0, \tag{17}$$

$$\frac{\partial \Pi_M^{\mathrm{BM}}}{\partial \theta} = -\frac{2\beta\theta\gamma^2 - 4\beta\eta\theta k - \alpha\eta c k + \alpha\eta k w}{\gamma^2 - 2\eta k} = 0. \tag{18}$$

By combining the equations (17) and (18), we derive that

$$w_M^{*\,\mathrm{BM}} = \frac{\eta c\alpha^2 k + 2\beta c\gamma^2 k + 2\beta a\gamma^2 - 4\beta\eta c k^2 - 4\beta\eta a k}{k\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)}, \tag{19}$$

$$\theta_M^{*\,\mathrm{BM}} = \frac{\alpha\eta c k - \alpha\eta a}{\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k}. \tag{20}$$

Submit (19) and (20) into the equations (14) and (15), and the equilibrium value of p_R^{BM} and e_R^{BM} is shown as

$$p_R^{*\,\mathrm{BM}} = \frac{\eta c\alpha^2 k + 2\beta c\gamma^2 k + 2\beta a r^2 - 2\beta\eta c k^2 - 6\beta\eta a k}{k\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)}. \tag{21}$$

$$e_R^{*\,\mathrm{BM}} = -\frac{2\beta\gamma(a - ck)}{\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k}. \tag{22}$$

Next, we submit (19)–(22) into equations (1), (11), and (12) and obtain the optimal actual market demand $q_M^{*\,\mathrm{BM}}$ and the maximized profits of the retailer ($\Pi_R^{*\,\mathrm{BM}}$) and manufacturer ($\Pi_M^{*\,\mathrm{BM}}$).

Lemma 2. *Under Lemma 1 and Proposition 1, the profit function Π_M^{BM} and Π_R^{BM} is strictly concave in w, θ and p, e, respectively.*

Proof (Appendix). □

Proposition 2. *In this model, the manufacturer's optimal whole price (w_M^{*BM}), water purity (θ_M^{*BM}), and maximized profit (Π_M^{*BM}); the retailer's retail price (p_R^{*BM}), marketing effort (e_R^{*BM}), and maximized profit (Π_R^{*BM}); the actual market demand (q_M^{*BM}), and the profit of the supply chain (Π_{SC}^{*BM}) are obtained as*

$$\begin{aligned}
w_M^{*\,\mathrm{BM}} &= \frac{\eta c\alpha^2 k + 2\beta c\gamma^2 k + 2\beta a\gamma^2 - 4\beta\eta c k^2 - 4\beta\eta a k}{k\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)},\\
\theta_M^{*\,\mathrm{BM}} &= \frac{\alpha\eta c k - \alpha\eta a}{\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k},\\
p_R^{*\,\mathrm{BM}} &= \frac{\eta c\alpha^2 k + 2\beta c\gamma^2 k + 2\beta a r^2 - 2\beta\eta c k^2 - 6\beta\eta a k}{k\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)},\\
e_R^{*\,\mathrm{BM}} &= -\frac{2\beta\gamma(a - ck)}{\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k},\\
\Pi_M^{*\,\mathrm{BM}} &= \frac{2\beta\eta a c k - \beta\eta a^2 - \beta\eta c^2 k^2}{\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k},\\
\Pi_R^{*\,\mathrm{BM}} &= \frac{-2\beta^2\eta(a - ck)^2\left(\gamma^2 - 2\eta k\right)}{\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^2},\\
\Pi_{\mathrm{SC}}^{*\mathrm{BM}} &= \frac{-\beta\eta(a - ck)^2\left(\alpha^2\eta + 6\beta\gamma^2 - 12\beta\eta k\right)}{\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^2},\\
q_M^{*\,\mathrm{BM}} &= \frac{2\beta\eta k(ck - a)}{\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k}.
\end{aligned} \tag{23}$$

Based on Lemma 1 and Proposition 1, the equilibrium values make sense. Moreover, to ensure that $0 < \theta_M^{*\,\mathrm{BM}} \le 1$, we get $\beta^{*\mathrm{BM}} \ge ((\eta\alpha(\mathrm{kc} - a - \alpha))/(4(\gamma^2 - 2k\eta)))$.

Proof (Appendix). □

3.2.3. Revenue-Sharing Contract (Model I). A revenue-sharing model (model I) is where manufacturers play a leading role, and a revenue-sharing contract is through the bargaining model (model II). In these models above, the proportion of income sharing on the premise of maximizing their own interests is decided by manufacturers and the bargaining between manufacturers and retailers, respectively.

In the manufacturer-led revenue-sharing model, the revenue-sharing ratio $\varphi\,(0 < \varphi < 1)$ is determined by manufacturers, which means that the proportion of retailer gains from the final revenue is φ, and the manufacture shares the remaining percentage $(1 - \varphi)$. Therefore, the profit function of the manufacturer and retailer is obtained as follows:

$$\begin{aligned}
\Pi_M^I &= (w - c)(a - \mathrm{kp} + \gamma e + \alpha\theta) - \beta\theta^2\\
&\quad + (1 - \varphi)(p - w)(a - \mathrm{kp} + \gamma e + \alpha\theta),
\end{aligned} \tag{24}$$

$$\Pi_R^I = \varphi(p - w)(a - kp + \gamma e + \alpha\theta) - \frac{\eta e^2}{2}. \tag{25}$$

Similar to the decision-making process of model BM, we get

RETRACTED

$$w_M^{*I}(\varphi) = \frac{\alpha^2\eta\mathrm{ck} + 2\beta\gamma^2\varphi\mathrm{ck} + 2\beta\gamma^2\varphi a - 4\beta\eta\mathrm{ck}^2 - 4\beta\eta\varphi\mathrm{ak}}{k\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)}, \tag{26}$$

$$\theta_M^{*I}(\varphi) = \frac{\alpha\eta(\mathrm{ck} - a)}{\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi}, \tag{27}$$

$$p_R^{*I}(\varphi) = \frac{-2\beta\eta\mathrm{ak} + 2\beta\gamma^2\varphi a + \alpha^2\eta\mathrm{ck} - 2\beta\eta\mathrm{ck}^2 + 2\beta\gamma^2\varphi\mathrm{ck} - 4\beta\eta\varphi\mathrm{ak}}{k\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)}, \tag{28}$$

$$e_R^{*I}(\varphi) = \frac{-2\beta\gamma\varphi(a - \mathrm{ck})}{\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi}. \tag{29}$$

Substituting equations (26)–(29) into equations (1), (24), and (25), we get the optimal market demand $(q_M^{*\mathrm{BM}})$ and the optimal profit of the manufacturer (Π_M^{*I}) and retailer (Π_R^{*I}) to get

$$q_M^{*I}(\varphi) = \frac{-2\beta\eta k(a - \mathrm{ck})}{\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi}, \tag{30}$$

$$\Pi_M^{*I}(\varphi) = -\frac{\beta\eta a^2 - 2\beta\eta\mathrm{ack} + \beta\eta c^2k^2}{\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi}, \tag{31}$$

$$\Pi_R^{*I}(\varphi) = \frac{-2\beta^2\eta\varphi(a - \mathrm{ck})^2\left(\gamma^2\varphi - 2\eta k\right)}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2}, \tag{32}$$

$$\Pi_{SC}^{*I}(\varphi) = \frac{-\beta\eta(a - ck)^2\left(\alpha^2\eta + 2\beta\gamma^2\varphi^2 + 4\beta\gamma^2\varphi - 8\beta\eta\varphi k - 4\beta\eta k\right)}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2}. \tag{33}$$

Lemma 3. *When $\gamma^2 < \eta k$, $\alpha^2 - 4\beta k < 0$, and $ck - a < 0$, the profit function Π_M^I is strictly concave in w and θ, and Π_R^I is strictly concave in p and e. Moreover, the equations (26)–(33) are meaningful. And to ensure $0 < \theta_M^{*I}(\varphi) \le 1$, we get $\beta^{*I} \ge ((\alpha(\alpha^2\gamma^2 - 4\beta\eta k^2)(\alpha + a - ck))/(4k^2(\alpha^2\eta - 8\beta\eta k + 4\beta\gamma^2)))$.*

Proof (Appendix). Since the first and second derivatives of Π_R^{*I} with respect to φ are

$$\frac{\partial\Pi_R^{*I}}{\partial\phi} = \frac{4\beta^2\eta^2(a - \mathrm{ck})^2\left(\alpha^2\eta k - 4\beta\eta k^2 + 4\beta\eta\varphi k^2 - \alpha^2\gamma^2\varphi\right)}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^3},$$

$$\frac{\partial^2\Pi_R^{*I}}{\partial\phi^2} < 0. \tag{34}$$

The optimal $\varphi^{*I} = ((4\beta\eta k^2 - \alpha^2\eta k)/(4\beta\eta k^2 - \alpha^2\gamma^2))$ is next put it into equations (26)–(33) to get: □

Proposition 3. *In model I, the manufacturer's optimal whole price (w_M^{*I}), water purity (θ_M^{*I}), maximized profit (Π_M^{*I}), the retailer's retail price (p_R^{*I}), marketing effort (e_R^{*I}), maximized profit (Π_R^{*I}), the actual market demand (q_M^{*I}), and the profit of the supply chain (Π_{SC}^{*I}) are obtained as*

$$\begin{aligned}
w_M^{*I} &= \frac{c\alpha^2\gamma^2 + 2\beta c\gamma^2k + 2\beta a\gamma^2 - 4\beta\eta\mathrm{ck}^2 - 4\beta\eta\mathrm{ak}}{\alpha^2\gamma^2 + 4\beta\gamma^2k - 8\beta\eta k^2},\\
\theta_M^{*I} &= \frac{-\alpha\left(\alpha^2\gamma^2 - 4\beta\eta k^2\right)(a - \mathrm{ck})}{\left(\alpha^2 - 4\beta k\right)\left(\alpha^2\gamma^2 + 4\beta\gamma^2k - 8\beta\eta k^2\right)},\\
p_R^{*I} &= \frac{c\alpha^4\gamma^2 - 4\eta c\alpha^2\beta k^2 - 4\eta a\alpha^2\beta k - 8c\beta^2\gamma^2k^2 - 8a\beta^2\gamma^2k + 8\eta c\beta^2k^3 + 24\eta a\beta^2k^2}{\left(\alpha^2 - 4\beta k\right)\left(\alpha^2\gamma^2 + 4\beta\gamma^2k - 8\beta\eta k^2\right)},\\
e_R^{*I} &= \frac{-2\beta\gamma k(a - \mathrm{ck})}{\alpha^2\gamma^2 + 4\beta\gamma^2k - 8\beta\eta k^2},\\
\Pi_M^{*I} &= \frac{-\beta\left(\alpha^2\gamma^2 - 4\beta\eta k^2\right)(a - \mathrm{ck})^2}{\left(\alpha^2 - 4\beta k\right)\left(\alpha^2\gamma^2 + 4\beta\gamma^2k - 8\beta\eta k^2\right)},\\
\Pi_R^{*I} &= \frac{2\beta^2\eta k^2(a - \mathrm{ck})^2}{\left(\alpha^2 - 4\beta k\right)\left(\alpha^2\gamma^2 + 4\beta\gamma^2k - 8\beta\eta k^2\right)},\\
\Pi_{SC}^{*I} &= \frac{-\beta\left(\alpha^2\gamma^2 - 6\beta\eta k^2\right)(a - \mathrm{ck})^2}{\left(\alpha^2 - 4\beta k\right)\left(\alpha^2\gamma^2 + 4\beta\gamma^2k - 8\beta\eta k^2\right)},\\
q_M^{*I} &= \frac{-2\beta k\left(\alpha^2\gamma^2 - 4\beta\eta k^2\right)(a - \mathrm{ck})}{\left(\alpha^2 - 4\beta k\right)\left(\alpha^2\gamma^2 + 4\beta\gamma^2k - 8\beta\eta k^2\right)}.
\end{aligned} \tag{35}$$

RETRACTED

Proof (Appendix). □

3.2.4. Revenue-Sharing Contract through Bargaining (Model II). Revenue-sharing contract through bargaining means that the revenue-sharing ratio is determined by the manufacturers and retailers through bargaining. To study the impact of bargaining on revenue-sharing contract, we adopt the vertical Nash game process. The decision-making sequence is as follows: in the first stage, the manufacture and the retailer bargain on the revenue-sharing ratio, φ, which means the retailer takes possession of φ proportion of the total revenue while the manufacture shares the remaining. In the second stage, the manufacture decides the wholesale price and water purity of drinking water by anticipating the retailer's retail price and the marketing effort. Finally, the retailer decides the retail price and marketing effort taking the manufacturer's whole price and water purity into consideration.

We construct the bargaining process between the supply chain members by using Nash bargain game. By substituting equations (31) and (32) into the function that $\Pi^{II}(\varphi) = \Pi_M^{*I}(\phi)\Pi_R^{*I}(\varphi)$, we can obtain

$$\Pi^{II} = \Pi_M^{*I}\Pi_R^{*I} = \frac{2\beta^3\eta^2\varphi(a-ck)^4\left(\gamma^2\varphi - 2\eta k\right)}{\left(\alpha^2\eta + 4\beta\gamma^2\varphi - 4\beta\eta k - 4\beta\eta\varphi k\right)^3}. \quad (36)$$

Lemma 4

(1) *When $\varphi^{*II} \le \sqrt{3}-1$, there does not exists a solution to the Nash bargaining problem*

(2) *The equilibrium value (φ) to this Nash bargaining problem is given as*

$$\varphi^{*II} = \frac{\eta\left(\alpha^2\gamma^2 + \sigma - 8\beta\eta k^2 + 4\beta\gamma^2 k\right)}{4\beta\gamma^2\left(\gamma^2 - \eta k\right)}, \quad (37)$$

where $\sigma = \sqrt{\alpha^4\gamma^4 - 8\alpha^2\beta\eta\gamma^2k^2 + 64\beta^2\eta^2k^4 - 96\beta^2\eta\gamma^2k^3 + 48\beta^2\gamma^4k^2}$

According to Cauchy inequality, we get $\varphi^{*II} \le (((\sqrt{3}-1)\eta k)/\gamma^2)$

Proposition 4. *The optimal strategies of wholesale price, water purity, retail price, marketing effort, product demand, the manufacturer's profit, retailer's profit, and the water supply chain's profit are displayed as*

$$\begin{aligned}
w_M^{*\mathrm{II}} &= \frac{\left(\gamma^2 a + \gamma^2 \mathrm{ck} - 2\eta \mathrm{ak}\right)\left(\alpha^2\gamma^2 + \sigma\right) + 2\left(\gamma^2 - \eta k\right)\left(\alpha^2\gamma^2\mathrm{ck} - 8\beta\eta k^2 a\right) + 4\beta\gamma^4 k(a - \mathrm{ck})}{2k\left(\gamma^2 - \eta k\right)\left(2\alpha^2\gamma^2 + \sigma - 8\beta\eta k^2\right)},\\
\theta_M^{*\mathrm{II}} &= \frac{-\gamma^2\alpha(a-\mathrm{ck})}{\left(2\alpha^2\gamma^2 + \sigma - 8\beta\eta k^2\right)},\\
p_R^{*\mathrm{II}} &= \frac{\left(\gamma^2 a + \gamma^2 \mathrm{ck} - 2\eta \mathrm{ak}\right)\left(\alpha^2\gamma^2 + \sigma - 4\beta\eta k^2\right) + 2\left(\gamma^2 - \eta k\right)\left(\alpha^2\gamma^2\mathrm{ck} - 4\beta\eta k^2 a\right)}{2k\left(\gamma^2 - \eta k\right)\left(2\alpha^2\gamma^2 + \sigma - 8\beta\eta k^2\right)},\\
e_R^{*\mathrm{II}} &= \frac{-\gamma(a-\mathrm{ck})\left(\alpha^2\gamma^2 + \sigma - 8\beta\eta k^2 + 4\beta\gamma^2 k\right)}{2\left(\gamma^2 - \eta \mathrm{k}\right)\left(2\alpha^2\gamma^2 + \sigma - 8\beta\eta k^2\right)},\\
\Pi_M^{*\mathrm{II}} &= \frac{-\beta\gamma^2(a-\mathrm{ck})^2}{\left(2\alpha^2\gamma^2 + \sigma - 8\beta\eta k^2\right)},\\
\Pi_R^{*\mathrm{II}} &= \frac{-\eta\gamma^2(a-\mathrm{ck})^2\left(\alpha^2\gamma^2 + \sigma - 4\beta\gamma^4 k\right)\left(\alpha^2\gamma^2 + \sigma - 8\beta\eta k^2 + 4\beta\gamma^4 k\right)}{8\left(\gamma^2 - \eta k\right)^2\left(2\alpha^2\gamma^2 + \sigma - 8\beta\eta k^2\right)^2},\\
\Pi_{\mathrm{SC}}^{*\mathrm{II}} &= \frac{-\gamma^2(a-\mathrm{ck})^2\left[2\gamma^2\left(\alpha^2\eta + 4\beta\gamma^4 - 8\beta\eta k\right)\left(\alpha^2\gamma^2 + \sigma\right) + 8\beta\gamma^2\left(\gamma^2 - \eta k\right)\left(\alpha^2\gamma^2 - 4\beta\eta k^2\right)\right]}{8\left(\gamma^2 - \eta k\right)^2\left(2\alpha^2\gamma^2 + \sigma - 8\beta\eta k^2\right)^2},\\
q_M^{*\mathrm{II}} &= \frac{-2\beta\gamma^2 k(a-\mathrm{ck})}{\left(2\alpha^2\gamma^2 + \sigma - 8\beta\eta k^2\right)}.
\end{aligned} \quad (38)$$

RETRACTED

3.3. Comparative Analysis

Proposition 5. *The water purity, retail price, wholesale price, and the retailer's marketing effort under the three models satisfy the following relationships which are derived through algebraic comparison:*

(1) $\theta_{SC}^{*B} > \theta_M^{*II} > \theta_M^{*I} > \theta_M^{*BM}$

(2) $e_{SC}^{*B} > e_R^{*BM} > e_R^{*I} > e_R^{*II}$

(3) $w_M^{*BM} > w_M^{*I} > w_M^{*II}$

(4) $q_{SC}^{*B} > q_M^{*II} > q_M^{*I} > q_M^{*BM}$

Proposition 5 distributes the differences among the strategies in terms of the product's water purity, the retailer's green marketing effort, the product's wholesale price and retail price, and product demand of the four models in this study.

It is natural that the product's water purity for model B (centralized model) is highest since it is the fully coordinated scenario and lowest under model BM (decentralized model without revenue-sharing contract). Moreover, product's water purity for revenue-sharing contract through bargaining is higher than that under revenue-sharing contract (i.e., $\theta_M^{*\mathrm{II}} > \theta_M^{*\mathrm{I}}$). Therefore, revenue-sharing contract is beneficial to the improvement of product's water purity and cooperation can contribute to it.

As for the comparison of product's water purity, naturally, it is highest in the fully coordinated scenario, while lowest under revenue-sharing contract situation (i.e., $e_R^{*\mathrm{BM}} > e_R^{*\mathrm{I}} > e_R^{*\mathrm{II}}$). According to the revenue-sharing contract, the retailer returns a percentage of its sales to the manufacturer and maintains profit through decreasing the marketing cost. Therefore, revenue-sharing contract leads to the decrease of the marketing effort and revenue-sharing contract though bargaining makes it worse.

The wholesale price is lowest in revenue-sharing contract through bargaining, followed by under revenue-sharing contract and highest in decentralized condition without any communication between supply chain members (i.e., $w_M^{*\mathrm{BM}} > w_M^{*\mathrm{I}} > w_M^{*\mathrm{II}}$). It is probably that the manufacturer sells products to the retailer at a wholesale price below the products' manufacturing cost. As a result, effective communication gives rise to the decline of the wholesale price.

Proof (Appendix). □

Proposition 6. *The water supply chain's profit under the four models meets the relationship:*

(1) $\Pi_M^{*II} > \Pi_M^{*I} > \Pi_M^{*BM}$ *and* $\Pi_R^{*I} > \Pi_R^{*BM}$

(2) $\Pi_{SC}^{*B} > \Pi_{SC}^{*II} > \Pi_{SC}^{*I} > \Pi_{SC}^{*BM}$

Proposition 6 shows the profit differences of the manufacturer and the retailer among the models. The manufacturer benefits from the revenue-sharing contract due to it as the Stackelberg leader, while the retail as the follower fails to benefit from the contract; only if $\varphi = 1$, *the retailer earns profit equal to that under the decentralized model without revenue-sharing contract. The comparison of green supply chain's profit indicates that there exists the double marginalization effect. It is very likely to be caused by the goals of supply chain members that perhaps conflict with each other. As a result, revenue-sharing contract are conducive to the boosting of the profit; furthermore, the profit has been increased even more under the revenue-sharing contract (i.e.,* $\Pi_{SC}^{*II} > \Pi_{SC}^{*I} > \Pi_{SC}^{*BM}$*). Therefore, the goal of constructing water supply chain is to realize integrated management, promote cooperation between upstream and downstream enterprises, and finally achieve higher overall performance.*

Proof (Appendix). □

Proposition 7. *In models B, BM, I, and II, we have*

(1) The increase of consumer sensitivity to water purity improvement (α) *induces the increase of the optimal wholesale price, water purity, retail price, marketing effort, manufacturer's profit, and retailer's profit*

(2) The increase of the cost rate of R&D (β) *leads to the decrease of the optimal wholesale price, water purity, retail price, marketing effort, manufacturer's profit, and retailer's profit*

Proof (Appendix). □

4. Numerical Analysis

In Section 4, we compare seven groups of parameters in the four models (B, BM, I, and II), including the water purity of the manufacturer, the green marketing level of the retailer, the wholesale price of the product, the actual market demand quantity of the product, the profit of the manufacturer, the profit of the retailer, and the total profit of the supply chain. In order to explain the effect of the optimal values, we set values to parameters as the following: $a = 20$, $k = 5$, $c = 3$, $\eta = 4$, $\gamma = 2$, and $\alpha = 4$. Seen from the four models, we get three different value ranges of the cost rate of research and development (R&D) (β), and

$$\beta \geq \max\left\{\frac{\eta\alpha(kc-a-\alpha)}{\left(\gamma^2-2k\eta\right)}, \frac{\eta\alpha(kc-a-\alpha)}{4\left(\gamma^2-2k\eta\right)}, \frac{\alpha\left(\alpha^2\gamma^2-4\beta\eta k^2\right)(\alpha+a-ck)}{4k^2\left(\alpha^2\eta-8\beta\eta k+4\beta\gamma^2\right)}\right\} \geq 4. \tag{39}$$

RETRACTED

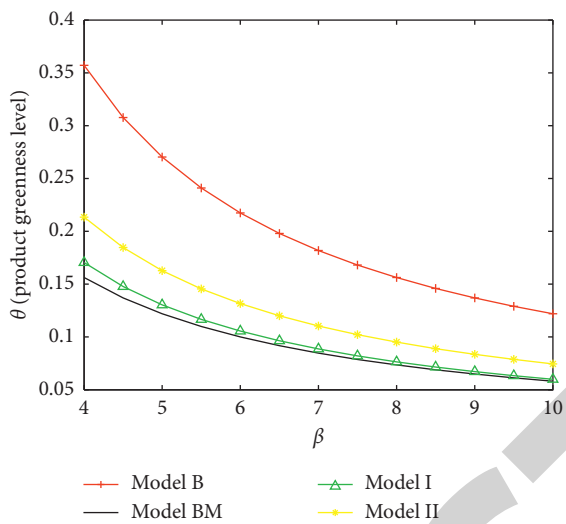

Figure 2: The comparison of optimal water purity.

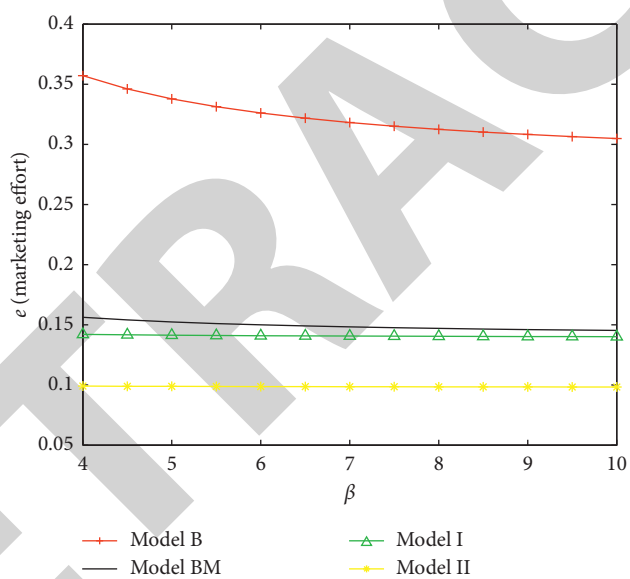

Figure 3: The comparison of the optimal marketing effort.

In addition, β decides the water purity directly; generally speaking, when the manufacturer increases the investment in research and development, the water purity will increase. Moreover, higher water purity usually possesses higher value, and the retailer is willing to make more effort to the marketing of the green product. Therefore, we assume that β is the independent variable.

The comparison results are shown in Figures 2–8 by taking advantage of Matlab 2013. As shown in Figure 2, the revenue-sharing contract model is superior to model BM (without any contract) in improving the water purity. And furthermore, the revenue-sharing contract through the bargaining model is better than the revenue-sharing contract model. Figure 3 demonstrates that the retailer makes the least marketing effort in model II to save cost, since the retailer has to share its revenue with the manufacturer. In Figure 4, there is no wholesale price in centralized condition as results of supply chain members are considered as a whole. Contract (revenue-sharing contract or revenue-sharing contract through bargaining) leads to the decrease of the product's wholesale price. Product with higher water purity is more likely to be accepted by consumers; as consequence, the sequence of product's actual market demand among the four models can be seen from Figure 5. In Figures 6 and 7, both the profit of manufacturer and the profit of retailer can be promoted through the contract model. Therefore, both of them will adopt revenue-sharing contract. In Figure 8, contracts (revenue-sharing contract and revenue-sharing contract through bargaining) contribute to the increase of the profit of the whole supply chain, and furthermore, the profit level of the latter contract is higher than that of the former contract.

RETRACTED

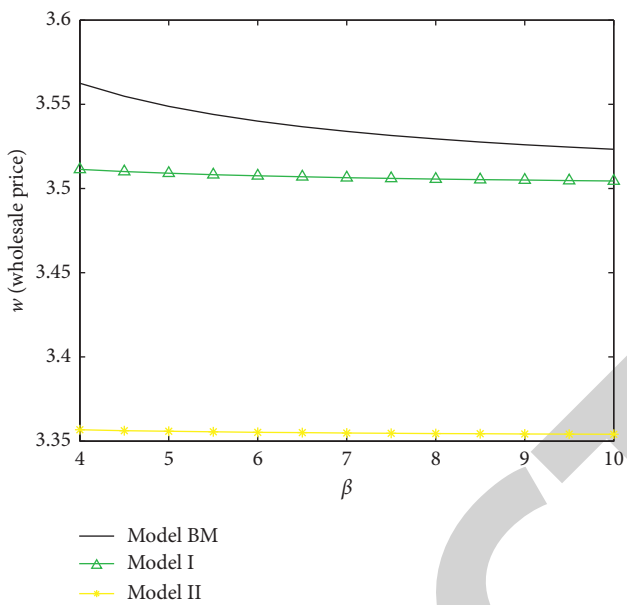

Figure 4: The comparison of the optimal wholesale price.

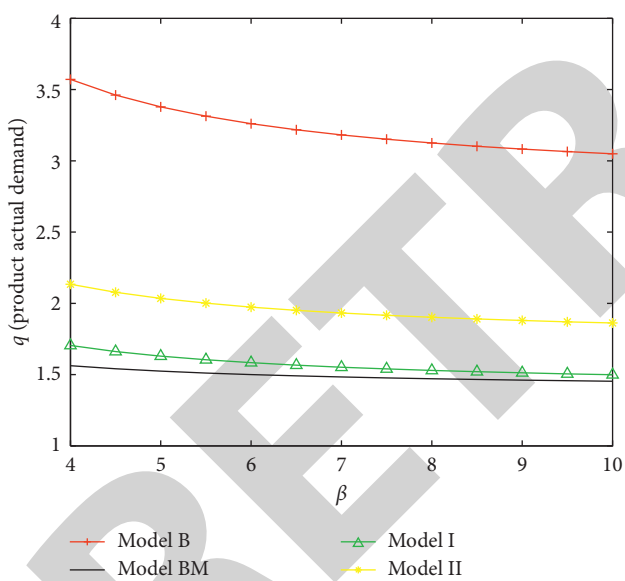

Figure 5: The comparison of the optimal product market demand.

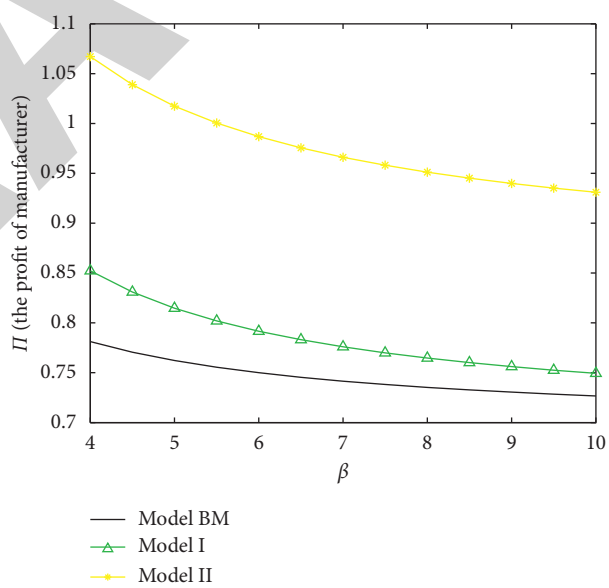

Figure 6: The comparison of the optimal manufacturer's profit.

RETRACTED

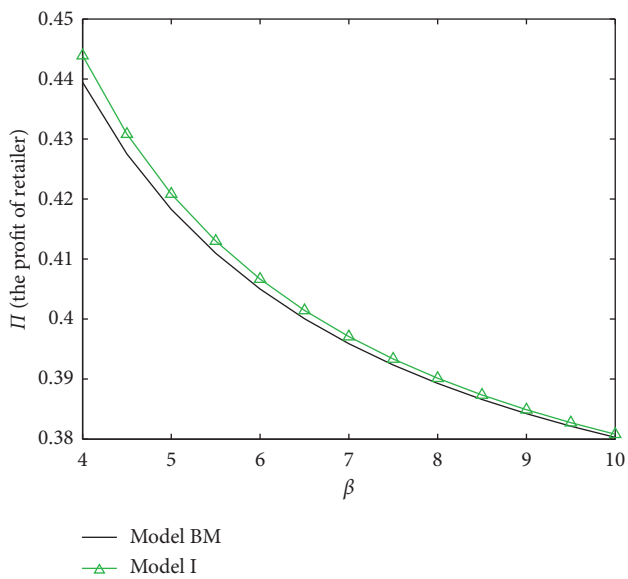

Figure 7: The comparison of the optimal retailer's profit.

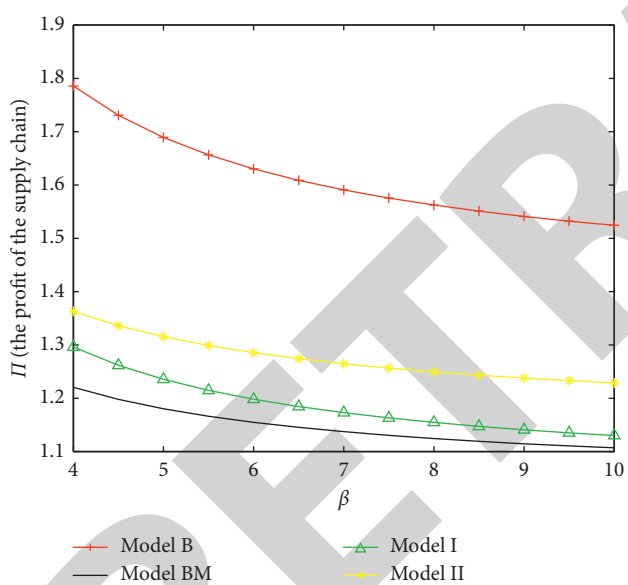

Figure 8: The comparison of the optimal supply chain's profit.

5. Conclusion

From the comparison above, the result shows that revenue-sharing contract is beneficial to the increase of water purity, the water supply chain members' profit, and the overall profit of water supply chain, while giving rise to the decrease of the retailer's marketing effort and the product's wholesale price compared with the decentralized model. Moreover, revenue-sharing contract through bargaining exert a more significant influence. In a word, revenue-sharing contract through bargaining eliminate the double marginal effect among the water supply chain more effectively and is an effective way to promote the cooperation among the water supply chain members. It is worth mentioning that revenue-sharing contract brings negative impact to the retailer's marketing effort. Marketing can stimulate the increase of the green product's market demand on the one hand, and on the other hand, it generates amount of marketing cost. In this study, the profit that marketing produces cannot offset the cost that it brings. Thus, it will be important to take some measures to make up the loss that marketing generated.

In this study, we have made a little innovation, which is that the marketing effort and water purity have been considered in the demand function. However, there are some shortcomings of this study. For example, first, we only consider a two-tier water supply chain; second, although the demand function has been revised, it is still a simple linear function concerning the marketing effort, water purity, and retail price, which makes the application of this model limited in a sense. In our further study, we will pay attention to two streams. One is that considering the supply chain that has more than one manufacturer and retailer. The other is to study the difference among revenue-sharing contract, costing-sharing contract, and mixed-sharing contract.

Management insights: by signing revenue-sharing contracts, manufacturers, wholesalers, and retailers can form a community of interests, always maintain the real-time interaction among them, get firsthand customer feedback and demand in a timely manner, and then receive orders according to customer demand. In this way, customized products should be manufactured to ensure that provided products are according to customer requirements. Overall, a virtuous loop should be established to realize value creation. Second, because revenue-sharing contracts weaken retailers' incentives to market green products, manufacturers can use other methods, such as sales discounts, exchange promises, and extended payback periods to motivate retailers. Third, the future market competition is the competition between the supply chains. Therefore, it is more and more important for the development of the supply chain to form a stable win-win partnership among all partners in the supply chain.

Appendix

A

Proof of Lemma 1: the Hessian matrix of Π_{SC}^{B} is

$$H(p,\theta,e)=\begin{bmatrix}\frac{\partial^2\Pi_{SC}^{B}}{\partial p^2} & \frac{\partial^2\Pi_{SC}^{B}}{\partial p\partial\theta} & \frac{\partial^2\Pi_{SC}^{B}}{\partial p\partial e}\\ \frac{\partial^2\Pi_{SC}^{B}}{\partial\theta\partial p} & \frac{\partial^2\Pi_{SC}^{B}}{\partial\theta^2} & \frac{\partial^2\Pi_{SC}^{B}}{\partial\theta\partial e}\\ \frac{\partial^2\Pi_{SC}^{B}}{\partial e\partial p} & \frac{\partial^2\Pi_{SC}^{B}}{\partial e\partial\theta} & \frac{\partial^2\Pi_{SC}^{B}}{\partial e^2}\end{bmatrix}=\begin{bmatrix}-2k & \alpha & \gamma\\ \alpha & -2\beta & 0\\ \gamma & 0 & -\eta\end{bmatrix}. \tag{A.1}$$

From the Hessian matrix above, we can get that

RETRACTED

$$\frac{\partial^2 \Pi_{SC}^B}{\partial p^2} = -2k < 0, \quad (k > 0),$$

$$\left| H_2(p,\theta,e) \right| = \begin{vmatrix} \frac{\partial^2 \Pi_{SC}^B}{\partial p^2} & \frac{\partial^2 \Pi_{SC}^B}{\partial p \partial \theta} \\ \frac{\partial^2 \Pi_{SC}^B}{\partial \theta \partial p} & \frac{\partial^2 \Pi_{SC}^B}{\partial \theta^2} \end{vmatrix} = \begin{vmatrix} -2k & \alpha \\ \alpha & -2\beta \end{vmatrix} = 4k\beta - \alpha^2,$$

$$\left| H_3(p,\theta,e) \right| = \begin{vmatrix} \frac{\partial^2 \Pi_{SC}^B}{\partial p^2} & \frac{\partial^2 \Pi_{SC}^B}{\partial p \partial \theta} & \frac{\partial^2 \Pi_{SC}^B}{\partial p \partial e} \\ \frac{\partial^2 \Pi_{SC}^B}{\partial \theta \partial p} & \frac{\partial^2 \Pi_{SC}^B}{\partial \theta^2} & \frac{\partial^2 \Pi_{SC}^B}{\partial \theta \partial e} \\ \frac{\partial^2 \Pi_{SC}^B}{\partial e \partial p} & \frac{\partial^2 \Pi_{SC}^B}{\partial e \partial \theta} & \frac{\partial^2 \Pi_{SC}^B}{\partial e^2} \end{vmatrix} = \eta\alpha^2 + 2\beta\gamma^2 - 4\beta\eta k. \tag{A.2}$$

If $\left| H_2(p,\theta,e) \right| = 4k\beta - \alpha^2 > 0$ and $\left| H_3(p,\theta,e) \right| = \eta\alpha^2 + 2\beta\gamma^2 - 4\beta\eta k < 0$, then Π_{SC}^B is strictly concave in p, e, and θ. The proof is completed. □

Proof of Proposition 1: from Lemma 1, we know that $\eta\alpha^2 + 2\beta\gamma^2 - 4\beta\eta k < 0$; therefore, the following inequalities should be met.

$$\begin{cases} c\left(\eta\alpha^2 + 2\beta\gamma^2 - 4\beta\eta k\right) + 2\beta\eta(ck - a) < 0, \\ \eta\alpha^2 + 2\beta\gamma^2 - 4\beta\eta k \le \eta\alpha(kc - a) < 0, \\ 2\beta\gamma(kc - a) < 0, \\ 2k\eta\beta(kc - a) < 0. \end{cases} \tag{A.3}$$

We can get the result $kc - a < 0$, $\gamma^2 - 2k\eta < 0$, and $\beta \ge ((\eta\alpha(kc - a - \alpha))/(\gamma^2 - 2k\eta))$.The proof is completed. □

Proof of Lemma 2: the Hessian Matrix of the manufacturer and retailer is in the following Hessian matrix of Π_M^{BM}:

$$H(w,\theta) = \begin{bmatrix} \frac{\partial^2 \Pi_M^B}{\partial w^2} & \frac{\partial^2 \Pi_M^B}{\partial w \partial \theta} \\ \frac{\partial^2 \Pi_M^B}{\partial \theta \partial w} & \frac{\partial^2 \Pi_M^B}{\partial \theta^2} \end{bmatrix} = \begin{bmatrix} \frac{2\eta k^2}{\gamma^2 - 2\eta k} & \frac{-\alpha\eta k}{\gamma^2 - 2\eta k} \\ \frac{-\alpha\eta k}{\gamma^2 - 2\eta k} & \frac{4\beta\eta k - 2\beta\gamma^2}{\gamma^2 - 2\eta k} \end{bmatrix},$$

$$|H(w,\theta)| = \frac{2\eta k^2}{\gamma^2 - 2\eta k} < 0,$$

$$\left| H_2(w,\theta) \right| = -\frac{\eta k^2\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)}{\left(\gamma^2 - 2\eta k\right)^2} > 0. \tag{A.4}$$

Hessian matrix of Π_R^{BM}

$$H(p,e) = \begin{bmatrix} \frac{\partial^2 \Pi_R^B}{\partial p^2} & \frac{\partial^2 \Pi_R^B}{\partial p \partial e} \\ \frac{\partial^2 \Pi_R^B}{\partial e \partial p} & \frac{\partial^2 \Pi_R^B}{\partial e^2} \end{bmatrix} = \begin{bmatrix} -2k & \gamma \\ \gamma & -\eta \end{bmatrix}, \tag{A.5}$$

$$|H(p,e)| = -2k < 0,$$

$$\left| H_2(p,e) \right| = 2k\eta - \gamma^2 > 0.$$

The proof is completed. □

Proof of Proposition 2

$$\because 0 < \theta_M^{*B} \le 1,$$

$$\therefore \eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k \le \alpha\eta ck - \alpha\eta a < 0,$$

$$\Longrightarrow \beta \ge \left((\eta\alpha(kc - a - \alpha))/\left(4\left(\gamma^2 - 2k\eta\right)\right)\right). \tag{A.6}$$

The proof is completed. □

Proof of Lemma 3: the Hessian matric of Π_M^I is

RETRACTED

$$\begin{bmatrix} \frac{\partial^2 \Pi_M^I}{\partial w^2} & \frac{\partial^2 \Pi_M^I}{\partial w \partial \theta} \\ \frac{\partial^2 \Pi_M^I}{\partial \theta \partial w} & \frac{\partial^2 \Pi_M^I}{\partial \theta^2} \end{bmatrix} = \begin{bmatrix} \frac{-2\eta k^2 \left[\eta k + \eta\varphi k - \gamma^2 \varphi\right]}{\left(\gamma^2 \varphi - 2\eta k\right)^2} & \frac{\alpha\eta k\varphi\left(2\eta k - \gamma^2\right)}{\left(\gamma^2 \varphi - 2\eta k\right)^2} \\ \frac{\alpha\eta k\varphi\left(2\eta k - \gamma^2\right)}{\left(\gamma^2 \varphi - 2\eta k\right)^2} & \frac{-2\left(\alpha^2\eta^2\varphi k - \alpha^2\eta^2 k + 4\beta\eta^2 k^2 - 4\beta\eta\gamma^2\varphi k + \beta\gamma^4\varphi^2\right)}{\left(\gamma^2 \varphi - 2\eta k\right)^2} \end{bmatrix},$$

$$\left| H(w,\theta) \right| = \frac{-2\eta k^2 \left[\eta k + \eta\varphi k - \gamma^2 \varphi\right]}{\left(\gamma^2 \varphi - 2\eta k\right)^2} < 0,$$

$$\left| H_2(w,\theta) \right| = \frac{-\left[\eta^2 k^2 \left(\alpha^2 - 4\beta k\right) - 4\beta\eta\varphi k^2 \left(\eta k - \gamma^2\right)\right]}{\left(\gamma^2 \varphi - 2\eta k\right)^2} > 0. \tag{A.7}$$

When $\alpha^2 - 4\beta k < 0$ and $\gamma^2 - \eta k < 0$, it satisfies.

The Hessian matric of Π_R^I is

$$\begin{bmatrix} \frac{\partial^2 \Pi_R^I}{\partial p^2} & \frac{\partial^2 \Pi_R^I}{\partial p \partial e} \\ \frac{\partial^2 \Pi_R^I}{\partial e \partial p} & \frac{\partial^2 \Pi_R^I}{\partial e^2} \end{bmatrix} = \begin{bmatrix} -2k\varphi & \gamma\varphi \\ \gamma\varphi & -\eta \end{bmatrix},$$

$$\left| H(p,e) \right| = -2k\varphi < 0,$$

$$\left| H_2(p,e) \right| = 2\eta k\varphi - \gamma^2\varphi^2 > 0. \tag{A.8}$$

The profit function Π_M^I is strictly concave in w and θ, and Π_R^I is strictly concave in p and e. □

Proof of Proposition 3: according to Lemma 3, Π_M^I is jointly concave in $(w_M^{*I}, \theta_M^{*I})$, and Π_R^I is jointly concave in (p_R^{*I}, e_R^{*I}). Therefore, we get the first partial derivative of Π_R^I with respect to p and e:

$$\frac{\partial \Pi_R^I}{\partial p} = \varphi(a - \mathrm{kp} + \alpha\theta + \gamma e) - \varphi k(p - w) = 0,$$

$$\frac{\partial \Pi_R^I}{\partial e} = \gamma\varphi(p - w) - \eta e = 0. \tag{A.9}$$

Next, solving the above equations to get the manufacturer forecasting the retail piece and marketing effort,

$$p_R^I = \frac{\eta a + \eta k w - \gamma^2 \varphi w + \alpha\eta\theta}{\gamma^2\varphi - 2\eta k},$$

$$e_R^I = \frac{-\gamma\varphi(a - kw + \alpha\theta)}{\gamma^2\varphi - 2\eta k}. \tag{A.10}$$

Put p_R^I and e_R^I into the manufacturers' profit function (24) to obtain

$$\Pi_M^I = \left(a - \mathrm{kp}_R^I + \gamma e_R^I + \alpha\theta\right)\left[w - c + \varphi\left(p_R^I - w\right)\right] - \beta\theta^2. \tag{A.11}$$

Similarly, we can get the only optimal solutions $(w_M^{*I}, \theta_M^{*I})$ by using the following first partial derivative of Π_M^I with respect to w and e.

RETRACTED

$$\frac{\partial \Pi_M^I}{\partial w} = \frac{-\eta k\left(\gamma^2\varphi a - 2\eta c k^2 + 2\eta k^2 w + \alpha\gamma^2\varphi\theta - 2\eta\varphi a k + \gamma^2\varphi c k + 2\eta\varphi k^2 w - 2\gamma^2\varphi k w - 2\alpha\eta\varphi\theta k\right)}{\left(\gamma^2\varphi - 2\eta k\right)^2},$$

$$\frac{\partial \Pi_M^I}{\partial \theta} = \frac{-\left(2\alpha\eta^2 c k^2 + 2\beta\gamma^4\varphi^2\theta - 2\alpha\eta^2 a k - 2\alpha^2\eta^2\theta k + 8\beta\eta^2\theta k^2 + 2\alpha^2\eta^2\varphi\theta k - 2\alpha\eta^2\varphi k^2 w + 2\alpha\eta^2\varphi a k - \alpha\eta\gamma^2 c k + \alpha\eta\gamma^2\varphi k w - 8\beta\eta\gamma^2\varphi\theta k\right)}{\left(\gamma^2\varphi - 2\eta k\right)^2}. \tag{A.12}$$

Then, the optimal solutions can be shown as follows:

$$\begin{aligned}
w_M^{*I}(\varphi) &= \frac{\alpha^2\eta \mathrm{ck} + 2\beta\gamma^2\varphi \mathrm{ck} + 2\beta\gamma^2\varphi a - 4\beta\eta \mathrm{ck}^2 - 4\beta\eta\varphi \mathrm{ak}}{k\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)},\\
\theta_M^{*I}(\varphi) &= \frac{\alpha\eta(\mathrm{ck} - a)}{\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi},\\
p_R^{*I}(\varphi) &= \frac{-2\beta\eta \mathrm{ak} + 2\beta\gamma^2\varphi a + \alpha^2\eta \mathrm{ck} - 2\beta\eta \mathrm{ck}^2 + 2\beta\gamma^2\varphi \mathrm{ck} - 4\beta\eta\varphi \mathrm{ak}}{k\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)},\\
e_R^{*I}(\varphi) &= \frac{-2\beta\gamma\varphi(a - \mathrm{ck})}{\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi}.
\end{aligned} \tag{A.13}$$

The proof is completed.

We put $w_M^{*I}(\varphi)$, $\theta_M^{*I}(\varphi)$, and $p_R^{*I}(\varphi)$, $e_R^{*I}(\varphi)$ into the manufacturers' profit function; then, we get a function of φ. Afterwards, we obtain the first and second derivatives of φ.

$$\begin{aligned}
\Pi_M^{*I}(\varphi) &= -\frac{\beta\eta a^2 - 2\beta\eta \mathrm{ack} + \beta\eta c^2 k^2}{\alpha^2\eta - 8\beta\eta k + 4\beta\gamma^2 + 4\beta\eta\varphi k - 4\beta\gamma^2\varphi},\\
\frac{\partial \Pi_M^{*I}}{\partial \varphi} &= \frac{\left(4\beta\gamma^2 - 4\beta\eta k\right)\left(\beta\eta a^2 - 2\beta\eta \mathrm{ack} + \beta\eta c^2 k^2\right)}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2} < 0,\\
\frac{\partial^2 \Pi_M^{*I}}{\partial \varphi^2} &= -\frac{2\left(4\beta\gamma^2 - 4\beta\eta k\right)^2\left(\beta\eta a^2 - 2\beta\eta \mathrm{ack} + \beta\eta c^2 k^2\right)}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^3} > 0.
\end{aligned} \tag{A.14}$$

Next, we put w_M^{*I}, θ_M^{*I}, and p_R^{*I}, e_R^{*I} into the retailers' profit function to get

RETRACTED

$$\Pi_R^{*I}(\varphi) = \frac{-2\beta^2\eta\varphi(a-\mathrm{ck})^2\left(\gamma^2\varphi - 2\eta k\right)}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2},$$

$$\frac{\partial\Pi_R^{*I}}{\partial\varphi} = \frac{4\beta^2\eta^2(a-\mathrm{ck})^2\left(\alpha^2\eta k - 4\beta\eta k^2 + 4\beta\eta\varphi k^2 - \alpha^2\gamma^2\varphi\right)}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^3},$$

$$\frac{\partial^2\Pi_R^{*I}}{\partial\varphi^2} = \frac{-4\beta^2\eta^2(a-\mathrm{ck})^2\left[64\beta^2\eta^2k^3 + \alpha^4\eta\gamma^2 - 16\alpha^2\beta\eta^2k^2 - 48\beta^2\eta\gamma^2k^2 - 32\beta^2\eta^2\varphi k^3 - 8\alpha^2\beta\gamma^4\varphi + 8\alpha^2\beta\eta\gamma^2k + 32\beta^2\eta\gamma^2\varphi k^2 + 8\alpha^2\beta\eta\gamma\varphi k\right]}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^4}. \tag{A.15}$$

Set

$$f(\varphi) = 64\beta^2\eta^2k^3 + \alpha^4\eta\gamma^2 - 16\alpha^2\beta\eta^2k^2 - 48\beta^2\eta\gamma^2k^2 - 32\beta^2\eta^2\varphi k^3 - 8\alpha^2\beta\gamma^4\varphi + 8\alpha^2\beta\eta\gamma^2k + 32\beta^2\eta\gamma^2\varphi k^2 + 8\alpha^2\beta\eta\gamma^2\varphi k,$$

$$\frac{\partial f(\varphi)}{\partial\varphi} = -32\beta^2\eta^2k^3 - 8\alpha^2\beta\gamma^4 + 32\beta^2\eta\gamma^2k^2 + 8\alpha^2\beta\eta\gamma^2k < 0,$$

$$f(0) = 64\beta^2\eta^2k^3 + \alpha^4\eta\gamma^2 - 16\alpha^2\beta\eta^2k^2 - 48\beta^2\eta\gamma^2k^2 + 8\alpha^2\beta\eta\gamma^2k,$$

$$f(1) = 32\beta^2\eta^2k^3 + \alpha^4\eta\gamma^2 - 16\alpha^2\beta\eta^2k^2 - 16\beta^2\eta\gamma^2k^2 - 8\alpha^2\beta\gamma^4 + 16\alpha^2\beta\eta\gamma^2k > 0,$$

$$\Longrightarrow 0 < f(1) < f(\varphi) < f(0),$$

$$\Longrightarrow \frac{\partial^2\Pi_R^{*I}}{\partial\varphi^2} < 0,$$

$$\Longrightarrow \varphi^{*I} = \frac{4\beta\eta k^2 - \alpha^2\eta k}{4\beta\eta k^2 - \alpha^2\gamma^2}. \tag{A.16}$$

The proof is completed. □

Proof of Lemma 4: the first-order derivative of Π^{III} with respect to φ is

$$\frac{\partial\Pi^{\mathrm{II}}}{\partial\varphi} = \frac{4\beta^3\eta^2(a-\mathrm{ck})^4 g(\varphi)}{\left(\alpha^2\eta + 4\beta\gamma^2\varphi - 4\beta\eta k - 4\beta\eta\varphi k\right)^4}, \tag{A.17}$$

where

$$g(\varphi) = \left(2\beta\eta\gamma^2k - 2\beta\gamma^4\right)\varphi^2 + \left(\alpha^2\eta\gamma^2 - 8\beta\eta^2k^2 + 4\beta\eta\gamma^2k\right)\varphi + 4\beta\eta^2k^2 - \alpha^2\eta^2k. \tag{A.18}$$

Since $g(0) = 4\beta\eta^2k^2 - \alpha^2\eta^2k > 0$, $g(1) = (\gamma^2 - \eta k)(\alpha^2\eta - 2\beta\gamma^2 + 4\beta\eta k) < 0$.

We set $g(\varphi) = 0$ to get

RETRACTED

$$\varphi_1 = \frac{\eta\left(\alpha^2\gamma^2 + \sigma - 8\beta\eta k^2 + 4\beta\gamma^2 k\right)}{4\beta\gamma^2\left(\gamma^2 - \eta k\right)},$$
$$\varphi_2 = \frac{\eta\left(\alpha^2\gamma^2 - \sigma - 8\beta\eta k^2 + 4\beta\gamma^2 k\right)}{4\beta\gamma^2\left(\gamma^2 - \eta k\right)}, \tag{A.19}$$

(abandoned)

$$\sigma = \sqrt{\alpha^4\gamma^4 - 8\alpha^2\beta\eta\gamma^2 k^2 + 64\beta^2\eta^2 k^4 - 96\beta^2\eta\gamma^2 k^3 + 48\beta^2\gamma^4 k^2 \le \left|4\beta\eta k^2 - \alpha^2\gamma^2\right| + \left|4\sqrt{3}\,\beta k\left(\eta k - \gamma^2\right)\right|},$$
$$\Longrightarrow \varphi^{*II} = \phi_1 \le \frac{\eta\left(-4\beta\eta k^2 + 4\beta\gamma^2 k\right)}{4\beta\gamma^2\left(\gamma^2 - \eta k\right)} = \frac{(\sqrt{3} - 1)\eta k}{\gamma^2}. \tag{A.20}$$

Proof of Proposition 5.

When $0 < \varphi < \varphi_1$, we have $g(\varphi) > 0$, $(\partial\Pi^{\mathrm{II}}/\partial\varphi) > 0$; and when $\varphi_1 < \varphi \le 1$, we have $g(\varphi) < 0$, $(\partial\Pi^{II}/\partial\varphi) < 0$.The proof is completed. □

$$(1)\ \frac{\theta_{\mathrm{SC}}^{*B}}{\theta_M^{*\mathrm{BM}}} = \frac{\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k}{\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta} = 1 + \frac{2\beta\gamma^2 - 4\beta\eta k}{\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta} > 1,$$
$$\theta_M^{*\mathrm{BM}} - \theta_M^{*I} = \frac{4\alpha^3\beta\left(\gamma^2 - \eta k\right)^2(a - \mathrm{ck})}{\left(\alpha^2 - 4\beta k\right)\left(\alpha^2\gamma^2 + 4\beta\gamma^2 k - 8\beta\eta k^2\right)\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)} < 0,$$
$$\theta_{\mathrm{SC}}^{*B} - \theta_M^{*I} = \frac{2\alpha\beta(a - \mathrm{ck})\left[\eta k\left(2\eta k - \gamma^2\right)\left(\alpha^2 - 4\beta k\right) - \gamma^2\alpha^2\left(\eta k - \gamma^2\right)\right]}{\left(\alpha^2 - 4\beta k\right)\left(\alpha^2\gamma^2 + 4\beta\gamma^2 k - 8\beta\eta k^2\right)\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)} > 0,$$
$$\Longrightarrow \theta_{\mathrm{SC}}^{*B} > \theta_M^{*I} > \theta_M^{*\mathrm{BM}}. \tag{A.21}$$

Owing to

RETRACTED

$$\varphi^{*I} - \varphi^{*II} \geq \frac{4\beta\eta k^2 - \alpha^2\eta k}{4\beta\eta k^2 - \alpha^2\gamma^2} - \frac{(\sqrt{3}-1)\eta k}{\gamma^2}$$

$$= \frac{(2-\sqrt{3})\gamma^2\eta k\left(4\beta\eta k - \alpha^2\right)}{\left(4\beta\eta k^2 - \alpha^2\gamma^2\right)\gamma^2} > 0,$$

$$\frac{\partial\theta_M^{*I}}{\partial\varphi} = \frac{4\beta\alpha\eta\left(\gamma^2 - \eta k\right)(a - \mathrm{ck})}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2} < 0, \tag{A.22}$$

to obtain $\theta_{\mathrm{SC}}^{*B} > \theta_M^{*II} > \theta_M^{*I} > \theta_M^{*\mathrm{BM}}$,

$$(2)\ e_R^{*\mathrm{BM}} - e_R^{*I} = \frac{-2\alpha^2\beta\gamma\left(\gamma^2 - \eta k\right)(a - \mathrm{ck})}{\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)\left(\alpha^2\gamma^2 + 4\beta\gamma^2 k - 8\beta\eta k^2\right)} > 0,$$

$$e_{\mathrm{SC}}^{*B} - e_R^{*\mathrm{BM}} = \frac{-4\beta^2\gamma\left(\gamma^2 - \eta k\right)(a - \mathrm{ck})}{\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)\left(\eta\alpha^2 + 2\beta\gamma^2 - 4\beta\eta k\right)} > 0,$$

$$\frac{\partial e_R^{*I}}{\partial\varphi} = \frac{2\eta\gamma\beta\left(\alpha^2 - 4\beta k\right)(\mathrm{ck} - a)}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2} > 0,$$

$$\Longrightarrow e_{\mathrm{SC}}^{*B} > e_R^{*\mathrm{BM}} > e_R^{*I}. \tag{A.23}$$

(3) Set $A = 2\beta c\gamma^2 k + 2\beta a\gamma^2 - 4\beta\eta \mathrm{ck}^2 - 4\beta\eta \mathrm{ak} < 0$ and $B = 4\beta\gamma^2 k - 8\beta\eta k^2 < 0$, to get

$$w_M^{*\mathrm{BM}} = \frac{\eta c\alpha^2 k + A}{k\eta\alpha^2 + B},$$

$$w_M^{*I} = \frac{c\alpha^2\gamma^2 + A}{\alpha^2\gamma^2 + B},$$

$$w_M^{*\mathrm{BM}} - w_M^{*I} = \frac{\alpha^2\left(k\eta - \gamma^2\right)(cB - A)}{\left(k\eta\alpha^2 + B\right)\left(\alpha^2\gamma^2 + B\right)} > 0, \tag{A.24}$$

$$cB - A = 2\beta(\mathrm{ck} - a)\left(\gamma^2 - 2\eta k\right) > 0,$$

$$\frac{\partial w_M^{*I}}{\partial\varphi} = \frac{2\beta\eta(\mathrm{ck} - a)\left(2\eta k - \gamma^2\right)\left(\alpha^2 - 4\beta k\right)}{k\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2} > 0,$$

$$\Longrightarrow w_M^{*\mathrm{BM}} > w_M^{*I} > w_M^{*II}.$$

RETRACTED

$$
\begin{aligned}
(4)\ q_{\mathrm{SC}}^{*B} - q_M^{*\mathrm{BM}} &= \frac{-4\beta^2\eta k\left(\gamma^2 - 2\eta k\right)(a - \mathrm{ck})}{\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)\left(\eta\alpha^2 + 2\beta\gamma^2 - 4\beta\eta k\right)} > 0,\\
q_M^{*\mathrm{BM}} - q_M^{*I} &= \frac{8\alpha^2\beta^2 k(a - \mathrm{ck})\left(\gamma^2 - \eta k\right)^2}{\left(\alpha^2 - 4\beta k\right)\left(\alpha^2\gamma^2 + 4\beta\gamma^2 k - 8\beta\eta k^2\right)\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)} < 0,\\
q_{\mathrm{SC}}^{*B} - q_M^{*I} &= \frac{4\beta^2 k(a - \mathrm{ck})\left(2\eta k^2\left(\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta\right) + \alpha^2\gamma^2\left(\gamma^2 - 2\eta k\right)\right)}{\left(\alpha^2 - 4\beta k\right)\left(\alpha^2\gamma^2 + 4\beta\gamma^2 k - 8\beta\eta k^2\right)\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)} > 0,\\
\frac{\partial q_M^{*I}}{\partial\varphi} &= \frac{8\beta^2\eta k\left(\gamma^2 - \eta k\right)(a - \mathrm{ck})}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2} < 0,\\
&\Longrightarrow q_{\mathrm{SC}}^{*B} > q_M^{*II} > q_M^{*I} > q_M^{*\mathrm{BM}}.
\end{aligned}
\tag{A.25}
$$

The proof is completed. □

Proof of Proposition 6

$$
\begin{aligned}
(1)\ \Pi_M^{*\mathrm{BM}} - \Pi_M^{*I} &= \frac{4\alpha^2\beta^2(a - \mathrm{ck})^2\left(\gamma^2 - \eta k\right)^2}{\left(\alpha^2 - 4\beta k\right)\left(\alpha^2\gamma^2 + 4\beta\gamma^2 k - 8\beta\eta k^2\right)\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)} < 0,\\
\frac{\partial\Pi_M^{*I}}{\partial\varphi} &= \frac{\left(4\beta\gamma^2 - 4\beta\eta k\right)\left(\beta\eta a^2 - 2\beta\eta\mathrm{ack} + \beta\eta c^2k^2\right)}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2} < 0,\\
&\Longrightarrow \Pi_M^{*II} > \Pi_M^{*I} > \Pi_M^{*\mathrm{BM}},\\
\Pi_R^{*\mathrm{BM}} - \Pi_R^{*I} &= \frac{-2\alpha^4\beta^2\eta(a - \mathrm{ck})^2\left(\gamma^2 - \eta k\right)^2}{\left(\alpha^2 - 4\beta k\right)\left(\alpha^2\gamma^2 + 4\beta\gamma^2 k - 8\beta\eta k^2\right)\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^2} < 0,\\
&\Longrightarrow \Pi_R^{*I} > \Pi_R^{*\mathrm{BM}}.
\end{aligned}
\tag{A.26}
$$

$$
\begin{aligned}
(2)\ \Pi_{\mathrm{SC}}^{*B} - \Pi_{\mathrm{SC}}^{*\mathrm{BM}} &= \frac{-4\beta^3\eta(a - \mathrm{ck})^2\left(\gamma^2 - 2\eta k\right)^2}{\left(\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta\right)\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^2} > 0,\\
\Pi_{\mathrm{SC}}^{*\mathrm{BM}} - \Pi_{\mathrm{SC}}^{*I} &= \frac{2\alpha^2\beta^2(a - \mathrm{ck})^2\left(\gamma^2 - \eta k\right)^2\left(\eta\alpha^2 + 8\beta\gamma^2 - 16\beta\eta k\right)}{\left(\alpha^2 - 4\beta k\right)\left(\alpha^2\gamma^2 + 4\beta\gamma^2 k - 8\beta\eta k^2\right)\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^2} < 0,\\
\Pi_{\mathrm{SC}}^{*B} - \Pi_{\mathrm{SC}}^{*I} &= \frac{2\beta^2(a - \mathrm{ck})^2\left(\eta k^2\left(\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta\right) + \alpha^2\gamma^2\left(\gamma^2 - 2\eta k\right)\right)}{\left(\alpha^2 - 4\beta k\right)\left(\alpha^2\gamma^2 + 4\beta\gamma^2 k - 8\beta\eta k^2\right)\left(\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta\right)} > 0,\\
\frac{\partial\Pi_{\mathrm{SC}}^{*I}}{\partial\varphi} &< 0,\\
&\Longrightarrow \Pi_{\mathrm{SC}}^{*B} > \Pi_{\mathrm{SC}}^{*I} > \Pi_{\mathrm{SC}}^{*\mathrm{BM}}.
\end{aligned}
\tag{A.27}
$$

RETRACTED

The proof is completed. □

Proof of Proposition 7. Take the first partial derivative of the equilibrium values among the models (B, BM, and I) with respect to α and β.

$$\frac{\partial \theta_{SC}^{*B}}{\partial \alpha} = \frac{-\eta(\mathrm{ck} - a)\left(\alpha^2\eta + 4\beta\eta k - 2\beta\gamma^2\right)}{\left(\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta\right)^2} > 0,$$

$$\frac{\partial \theta_{SC}^{*B}}{\partial \beta} = \frac{2\alpha\eta\left(\gamma^2 - 2\eta k\right)(a - \mathrm{ck})}{\left(\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta\right)^2} < 0,$$

$$\frac{\partial e_{SC}^{*B}}{\partial \alpha} = \frac{4\alpha\eta\beta\gamma(a - \mathrm{ck})}{\left(\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta\right)^2} > 0,$$

$$\frac{\partial e_{SC}^{*B}}{\partial \beta} = \frac{-2\alpha^2\eta\gamma(a - \mathrm{ck})}{\left(\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta\right)^2} < 0,$$

$$\frac{\partial p_{SC}^{*B}}{\partial \alpha} = \frac{4\alpha\eta^2\beta(a - \mathrm{ck})}{\left(\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta\right)^2} > 0,$$

$$\frac{\partial p_{SC}^{*B}}{\partial \beta} = \frac{-2\alpha^2\eta^2(a - \mathrm{ck})}{\left(\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta\right)^2} < 0,$$

$$\frac{\partial \Pi_{SC}^{*B}}{\partial \alpha} = \frac{2\alpha\eta^2\beta(a - \mathrm{ck})^2}{\left(\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta\right)^2} > 0,$$

$$\frac{\partial \Pi_{SC}^{*B}}{\partial \beta} = \frac{-\alpha^2\eta^2(a - \mathrm{ck})^2}{\left(\alpha^2\eta + 2\gamma^2\beta - 4k\eta\beta\right)^2} < 0,$$

RETRACTED

$$\frac{\partial w_M^{*\mathrm{BM}}}{\partial \alpha} = \frac{4\alpha\beta\eta\left(\gamma^2 - 2\eta k\right)(\mathrm{ck} - a)}{k\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^2} > 0,$$

$$\frac{\partial w_M^{*\mathrm{BM}}}{\partial \beta} = \frac{2\alpha^2\eta\left(2\eta k - \gamma^2\right)(\mathrm{ck} - a)}{k\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^2} < 0,$$

$$\frac{\partial \theta_M^{*\mathrm{BM}}}{\partial \alpha} = \frac{\eta(a - \mathrm{ck})\left(\eta\alpha^2 - 4\beta\gamma^2 + 8\beta\eta k\right)}{\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^2} > 0,$$

$$\frac{\partial \theta_M^{*\mathrm{BM}}}{\partial \beta} = \frac{4\alpha\eta(a - \mathrm{ck})\left(\gamma^2 - 2\eta k\right)}{\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^2} < 0,$$

$$\frac{\partial p_R^{*\mathrm{BM}}}{\partial \alpha} = \frac{4\alpha\beta\eta(\mathrm{ck} - a)\left(\gamma^2 - 3\eta k\right)}{k\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^2} > 0,$$

$$\frac{\partial p_R^{*\mathrm{BM}}}{\partial \beta} = \frac{2\alpha^2\eta(\mathrm{ck} - a)\left(3\eta k - \gamma^2\right)}{k\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^2} < 0,$$

$$\frac{\partial e_R^{*\mathrm{BM}}}{\partial \alpha} = \frac{4\alpha\eta\beta\gamma(a - \mathrm{ck})}{\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^2} > 0,$$

$$\frac{\partial e_R^{*\mathrm{BM}}}{\partial \beta} = \frac{2\alpha^2\eta\gamma(\mathrm{ck} - a)}{\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^2} < 0,$$

$$\frac{\partial \Pi_M^{*\mathrm{BM}}}{\partial \alpha} = \frac{2\alpha\beta\eta^2(a - \mathrm{ck})^2}{\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^2} > 0,$$

$$\frac{\partial \Pi_M^{*\mathrm{BM}}}{\partial \beta} = \frac{-\alpha^2\eta^2(a - \mathrm{ck})^2}{\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^2} < 0,$$

$$\frac{\partial \Pi_R^{*\mathrm{BM}}}{\partial \alpha} = \frac{8\alpha\beta^2\eta^2\left(\gamma^2 - 2\eta k\right)(a - \mathrm{ck})^2}{\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^3} > 0,$$

$$\frac{\partial \Pi_R^{*\mathrm{BM}}}{\partial \beta} = \frac{-4\alpha^2\beta\eta^2\left(\gamma^2 - 2\eta k\right)(a - \mathrm{ck})^2}{\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^3} < 0,$$

$$\frac{\partial \Pi_{\mathrm{SC}}^{*\mathrm{BM}}}{\partial \alpha} = \frac{2\alpha\beta\eta^2(a - \mathrm{ck})^2\left(\eta\alpha^2 + 8\beta\gamma^2 - 16\beta\eta k\right)}{\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^3} > 0,$$

$$\frac{\partial \Pi_{\mathrm{SC}}^{*\mathrm{BM}}}{\partial \beta} = \frac{-\alpha^2\eta^2(a - \mathrm{ck})^2\left(\eta\alpha^2 + 8\beta\gamma^2 - 16\beta\eta k\right)}{\left(\eta\alpha^2 + 4\beta\gamma^2 - 8\beta\eta k\right)^3} < 0,$$

$$\frac{\partial w_M^{*I}}{\partial \alpha} = \frac{4\alpha\beta\eta\varphi\left(\gamma^2 - 2\eta k\right)(\mathrm{ck} - a)}{k\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2} > 0,$$

$$\frac{\partial w_M^{*I}}{\partial \beta} = \frac{2\alpha^2\eta\varphi\left(2\eta k - \gamma^2\right)(\mathrm{ck} - a)}{k\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2} < 0,$$

RETRACTED

$$\frac{\partial \theta_M^{*I}}{\partial \alpha} = \frac{(a-ck)\left[\alpha^2\eta^2 + 4\beta\eta^2 k + 4\beta\eta\varphi\left(\eta k - \gamma^2\right)\right]}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2} > 0,$$

$$\frac{\partial \theta_M^{*I}}{\partial \beta} = \frac{4\alpha\eta(a-\mathrm{ck})\left(\varphi\gamma^2 - \eta k - \eta k\varphi\right)}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2} < 0,$$

$$\frac{\partial p_R^{*I}}{\partial \alpha} = \frac{4\alpha\eta\beta(a-\mathrm{ck})\left(\eta k - \gamma^2\varphi + 2\eta\varphi k\right)}{k\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2} > 0,$$

$$\frac{\partial p_R^{*I}}{\partial \beta} = \frac{-2(a-\mathrm{ck})\left(\eta k - \gamma^2\varphi + 2\eta\varphi k\right)}{k\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2} < 0,$$

$$\frac{\partial e_R^{*I}}{\partial \alpha} = \frac{4\alpha\beta\eta\gamma\varphi(a-\mathrm{ck})}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2} > 0,$$

$$\frac{\partial e_R^{*I}}{\partial \beta} = \frac{-2\alpha^2\eta\gamma\varphi(a-\mathrm{ck})}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2} < 0,$$

$$\frac{\partial \Pi_M^{*I}}{\partial \alpha} = \frac{2\alpha\beta\eta^2(a-\mathrm{ck})^2}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2} > 0,$$

$$\frac{\partial \Pi_M^{*I}}{\partial \beta} = \frac{-\alpha^2\eta^2(a-\mathrm{ck})^2}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^2} < 0,$$

$$\frac{\partial \Pi_R^{*I}}{\partial \alpha} = \frac{8\alpha\beta^2\eta^2\varphi(a-\mathrm{ck})^2\left(\gamma^2\varphi - 2\eta k\right)}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^3} > 0,$$

$$\frac{\partial \Pi_R^{*I}}{\partial \beta} = \frac{-4\alpha^2\beta\eta^2\varphi(a-\mathrm{ck})^2\left(\gamma^2\varphi - 2\eta k\right)}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^3} < 0,$$

$$\frac{\partial \Pi_R^{*I}}{\partial \beta} = \frac{-4\alpha^2\beta\eta^2\varphi(a-\mathrm{ck})^2\left(\gamma^2\varphi - 2\eta k\right)}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^3} < 0,$$

$$\frac{\partial \Pi_{SC}^{*I}}{\partial \alpha} = \frac{2\alpha\beta^2\eta(a-\mathrm{ck})^2\left(\eta\alpha^2 + 4\beta\gamma^2\varphi^2 + 4\beta\gamma^2\varphi - 12\beta\eta k\varphi - 4\beta\eta k\right)}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^3} > 0,$$

$$\frac{\partial \Pi_R^{*I}}{\partial \beta} = \frac{-\eta(a-\mathrm{ck})^2\left(\alpha^4\eta^2 - 12\beta k\alpha^2\eta^2\varphi - 4\beta k\alpha^2\eta^2 + 4\beta\alpha^2\eta\gamma^2\varphi^2 + 4\beta\alpha^2\eta\gamma^2\varphi\right)}{\left(\alpha^2\eta - 4\beta\eta\varphi k - 4\beta\eta k + 4\beta\gamma^2\varphi\right)^3} < 0. \tag{A.28}$$

□

Data Availability

The (numeric) data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This work was supported in part by Key Technologies R&D Program of China (2017YFC0405805-04).

References

[1] H. Li, "Research on the relationship between green brand and consumer purchase intention," *China Business and Market*, vol. 32, no. 7, pp. 56–62, 2018.

[2] C. Jin, E. Cao, and M. Lai, "Analysis on green marketing strategy of duopoly retailing market based on the evolutionary game theory," *Journal of System Engineering*, vol. 27, no. 3, pp. 383–389, 2012.

[3] W. Du, Y. Fan, and L. Yan, "Pricing strategies for competitive water supply chains under different power structures: an application to the South-to-North water diversion project in China," *Sustainability*, vol. 10, no. 8, 2018.

[4] D. Ghosh and J. Shah, "A comparative analysis of greening policies across supply chain structures," *International Journal of Production Economics*, vol. 135, no. 2, pp. 568–583, 2012.

RETRACTED

[5] L. L. Zhang, N. W. Zhang, and Z. Z. Wang, "CAS paradigm applied to water resources supply chain management in the east route of South-to-North water transfer project," *Journal of Hohai University (Natural Science)*, vol. 32, no. 6, pp. 703–706, 2004.

[6] I. N. Athanasiadis, A. K. Mentes, P. A. Mitkas, and Y. A. Mylopoulos, "A hybrid agent-based model for estimating residential water demand," *Simulation*, vol. 81, no. 3, pp. 175–187, 2005.

[7] H. M. Wang and Z. Y. Hu, "Several issues on South-to-North water transfer project supply chain operations management," *Advances in Water Science*, vol. 16, no. 6, pp. 864–869, 2005.

[8] J. L. Zhu and H. M. Wang, "Stochastic control of bullwhip effect in SCM of water resource of South-to-North Water transfer," *System Engineering*, vol. 23, no. 5, pp. 1–6, 2005.

[9] E. Kondili and J. K. Kaldellis, "Model development for the optimal water systems planning," *Computer Aided Chemical Engineering*, vol. 21, 2006.

[10] J. L. Zhu, "A water collocation model for supply chain in South-to-North water transfer project," *System Engineering*, vol. 25, no. 11, pp. 31–35, 2007.

[11] H. M. Wang, L. Zhang, and W. Yang, "Pricing model of water resources supply chain for east-route South-to-North Water transfer project," *Shui Li Xue Bao*, vol. 39, no. 6, pp. 758–762, 2008.

[12] L. Zhang, H. M. Wang, and W. Yang, "A discriminatory pricing model and simulation to different markets of eastern route of the South-to-North water transfers supply chain," *System Engineering*, no. 3, pp. 120–123, 2008.

[13] S. Ahmed, "Supply chain planning for water distribution in Central Asia," *Industrial Management & Data Systems*, vol. 109, no. 1, pp. 53–73, 2009.

[14] K. Kogan and C. S. Tapiero, "Water supply and consumption uncertainty: a conflict-equilibrium," *Annals of Operations Research*, vol. 181, no. 1, pp. 199–217, 2010.

[15] D. Elala, P. Labhasetwar, and S. F. Tyrrel, "Deterioration in water quality from supply chain to household and appropriate storage in the context of intermittent water supplies," *Water Supply*, vol. 11, no. 4, pp. 400–408, 2011.

[16] J. Zhou, Y. Su, and Y. Zhang, "Enlightenment on the risk management and risk assessment of water source and water supply system in European countries," *Journal of Safety and Environment*, vol. 12, no. 02, pp. 138–142, 2012.

[17] A. Borghi, C. Strazza, M. Gallo, S. Messineo, and M. Naso, "Water supply and sustainability: life cycle assessment of water collection, treatment and distribution service," *The International Journal of Life Cycle Assessment*, vol. 18, no. 5, 2013.

[18] Y. Saif and A. Almansoori, "Design and operation of water desalination supply chain using mathematical modelling approach," *Desalination*, vol. 351, 2014.

[19] S. Behboudian, M. Tabesh, M. Falahnezhad, and F. A. Ghavanini, "A long-term prediction of domestic water demand using preprocessing in artificial neural network," *Journal of Water Supply: Research and Technology-Aqua*, vol. 63, no. 1, 2014.

[20] L. X. He and S. H. He, "Solving water resource scheduling problem through an improved artificial fish swarm algorithm," *International Journal of Simulation Modelling*, vol. 14, no. 1, pp. 170–181, 2015.

[21] N. Papageorgiou, B. Magoutas, G. Mentzas, J. Kutterer, K. Schnitter, and A. Abecker, "Data and system interoperability in the drink-water supply chain," in *Proceedings of the 36th World Congress*, pp. 7060–7069, Hague, The Netherlands, June 2015.

[22] L. L. Zhang, H. M. Wang, and Z. Z. Wang, "Multi-level cooperative decision-making model for water resources supply chain of east route of South-to-North water transfer project under seasonal demand," *Journal of Hohai University (Natural Science)*, vol. 33, no. 6, pp. 14–17, 2005.

[23] J. Dai and C. M. Ji, "A competition equilibrium model on the diverse-source water supply market created by interbasin water transfer," in *Proceedings of the 2006 International Conference on Management Science and Engineering*, pp. 995–1000, Lille, France, October 2006.

[24] J. L. Zhu, X. Y. Tao, and S. J. Wang, "Water inventory coordination of South-to-North water transfer project supply chain based on the theory of VMI," *Chinese Journal of Management Science*, vol. 14, no. 6, pp. 98–103, 2006.

[25] E. Kondili and J. K. Kaldellis, "Development and operation issues of a decision support system for water management in areas with water resources," *Fresenius Environmental Bulletin*, vol. 17, no. 9B, pp. 1412–1419, 2008.

[26] H. Wang, Z. Chen, and S.-I. I. Su, "Optimal pricing and coordination schemes for the eastern route of the South-to-North water diversion supply chain system in China," *Transportation Journal*, vol. 51, no. 4, 2012.

[27] Z. S. Chen, "Coordination mechanisms for South-to-North water diversion: economic benefit and social responsibility," *Resources Science*, vol. 35, no. 6, pp. 1245–1253, 2013.

[28] W. Y. Du, X. Z. Ai, and X. W. Tang, "The South-to-North water diversion supply chain operation strategy research under competition environment," in *Proceedings of the 22nd International Conference on Management Science and Engineering*, pp. 472–478, Aveiro, Portugal, July 2015.

[29] W. Du, Y. Fan, and X. Tang, "Two-part pricing contracts under competition: the South-to-North water transfer project supply chain system in China," *International Journal of Water Resources Development*, vol. 32, no. 6, 2016.

[30] M. N. Koleva, A. J. Calderón, D. Zhang, C. A. Styan, and L. G. Papageorgiou, "Integration of environmental aspects in modelling and optimisation of water supply chains," *Science of the Total Environment*, vol. 636, no. 15, pp. 314–338, 2018.

[31] Z. Chen, S.-I. I. Su, and H. Wang, "Inter-basin water transfer supply chain equilibrium and coordination: a social welfare maximization perspective," *Water Resources Management*, vol. 33, no. 7, pp. 2577–2598, 2019.

[32] W. Du, Y. Fan, X. Liu, S. C. Park, and X. Tang, "A game-based production operation model for water resource management: an analysis of the South-to-North Water Transfer Project in China," *Journal of Cleaner Production*, vol. 228, no. 10, pp. 1482–1493, 2019.

[33] W. Du, Y. Fan, X. Liu et al., "Two-part pricing contract and competition between two water supply chains: a theoretical and empirical analysis of the South-to-North Water Transfer Project in China," *Journal of Water Supply: Research and Technology-AQUA*, vol. 68, no. 3-4, pp. 197–209, 2019.

[34] X. Chen and Z. Chen, "Joint pricing and inventory management of interbasin water transfer," *Supply Chain[J]. Complexity*, vol. 2020, Article ID 3954084, 2020.

[35] S. K. Mukhopadhyay, X. M. Su, and S. Ghose, "Motivating retail marketing effort: optimal contract design," *Production and Operations Management*, vol. 18, no. 2, pp. 19–211, 2009.

[36] D. D. Wu, "Bargaining in supply chain with price and promotional effort dependent demand," *Mathematical and Computer Modelling*, vol. 58, no. 9-10, pp. 1659–1669, 2013.

RETRACTED

[37] P. Ma, K. W. Li, and Z.-J. Wang, "Pricing decisions in closed-loop supply chains with marketing effort and fairness concerns," *International Journal of Production Research*, vol. 55, no. 22, pp. 6710–6731, 2017.
[38] H. Song and X. Gao, "Green supply chain game model and analysis under revenue-sharing contract," *Journal of Cleaner Production*, vol. 170, pp. 183–192, 2018.

RETRACTED