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Pricing strategy of innovative product in supply chain considering anticipated regret

Nian Zhang[a,b], Qi Tian[a], Bin Li[c] and Jin Liu[a]

[a]School of Economics and Management, Chongqing University of Posts and Telecommunications, Chongqing, P.R. China; [b]Chongqing Municipal Education Commission Digital Economy Innovation and Industrial Development Research Team, Chongqing, P.R. China; [c]School of Business Administration, Northeastern University, Shenyang, P.R. China

ABSTRACT

Product innovation is a significant marketing strategy for enterprises to attract customers. However, innovative products may not meet consumers' expectations, where consumers would regret and return after purchasing the products. Firstly, a Stackelberg game is constructed in this paper model under different supply chain power structures. And then, the impact of consumers' anticipated regret and innovation attributes are discussed on the equilibrium results and supply chain profit through theoretical comparison and numerical simulation. The results show that: (1) Sales enterprise can adopt the strategy of pricing penetration to promote the demand and avoid selling risk. (2) Enterprise can provide customers with high value-added services to increase profit. (3) Manufacturing enterprise can adopt the additive value strategy to promote consumption and gain extra profit. The conclusion can provide reference opinions for enterprises' innovation and pricing decision-making. However, the different regret coefficients for innovative products and current products are not considered in this paper. Further the situation is considered in which consumers purchase current product, discount product and innovative product.

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1. Introduction

Nowadays, with the improvement of people's requirements for the quality of life, more and more consumers are more inclined to buy innovative products. Product innovation has become a key strategic choice for all kinds of manufacturing enterprises to gain market competitive advantages. In 2021, Coca-Cola's net profit increased by 14.7% year-on-year, mainly due to the launch of its new products and new flavors. Innovative products mean more expectations of consumers, so if consumer expectations cannot be met, innovation product leads to a decline in product

CONTACT Nian Zhang chinazhangnian@163.com

sales. The fifth generation of Land Rover Discovery has upgraded product performance, but the innovation of its appearance has triggered the hesitation of consumers, causing sales to plummet. Apple's product innovation has encountered the same problem. Apple promulgated iPhone 11 in 2019, and innovative iPhone 12 in 2020 to attract consumers. Even though consumers have learned about the features and prices of product via the Internet, consumers also have a certain fear of regret after purchase, which leads to the highest return rate of the iPhone 12 in history. The return behavior caused by consumers' regret would affect their final purchase decision, and then affect the profit of the entire supply chain. Product innovation is a very important strategy especially for high-tech products such as mobile smart devices and software (Rao et al., 2014). In the imperfectly competitive market, many high-tech manufacturers such as SAMSUNG and HUAWEI can dominate the supply chain. But in the age of big data, the more data and information, the more power. The retailers get closer to consumers and have more data resources, their advantages in the supply chain are gradually manifested, such as JD.com and Alibaba, who gradually gained more power. In the perfectly competitive market, manufacturers and retailers are equality and not leader. Different market leadership structures would change the competitive relationship among enterprises in the supply chain (Wang et al., 2011). Therefore, for the innovation supply chain, different power structures have different impacts.

Existing research has combined product innovation with consumer behavior. Plambeck and Wang found the price of innovative product increased with its quality and consumers' rational expectation of the launch time of innovative products (Plambeck & Wang, 2009). Feng and Han studied the negative impact of consumer hesitation on the demand for innovative products (Feng & Han, 2019). Huang and Zhang showed that the level of product innovation and consumers' perception of innovation had an important impact on manufacturers' product pricing and consumers' replacement strategies (Huang & Zhang, 2021). Niu and Xia found that the impact of strategic consumer purchase behavior on manufacturer's product innovation depends not only on the manufacturer's pricing strategy, but also on the product value discount coefficient (Niu & Xia, 2021). Most of the above articles consider the factors that product innovation affects consumer behavior, few articles have introduced the anticipated regret caused by innovative products into the research of supply chain.

Facing with the increasingly complex consumers' behavior in the market (Katok & Pavlov, 2013), classical game theory often assumes that consumers are completely rational, but many psychologists and behavioral economists have found that consumers have only bounded rationality. Croson and Donohue suggested that more attention should be paid to identify and understand various behavioral preferences in the supply chain (Croson & Donohue, 2002). Boudreau et al. pointed out that if actual decision-making behavior could not be taken into account in the supply chain, the scientific nature of theoretical model and practicability of conclusions would be very limited (Boudreau et al., 2003). In recent years, the problem of limited rational behavior in supply chain has attracted extensive attention. Some scholars have studied the supply chain under the influence of consumers' anticipated regret behavior. For

example, Diecidue et al. classified consumers according to the cause of regret behavior, and then discussed the impact of inconsistent consumers' type on purchase decisions (Diecidue et al., 2012). Jiang et al. proposed the calculation formula of consumers' anticipated regret, and found that anticipated regret would affect the profit and innovation of enterprises (Jiang et al., 2017). Liu and Zhang established a two-stage dynamic game model of retail enterprises and consumers under the product innovation strategy, and found that consumers would have different optimal purchase options under different regret intensities (Liu & Zhang, 2017). For the remanufacturing supply chain, Gao et al. discussed the influence of consumers' anticipated regret on the choice of supply chain operation modes of perfect competition, integration and channel cooperation (Gao et al., 2017). Duan et al. analyzed the impact of conversion purchase regret and repeat purchase regret on pricing and product quality innovation, where the results show that conversion purchase regret has a negative impact on manufacturers' profits which promotes innovation, and repeat purchase regret has a positive impact on manufacturers' profits which hinders innovation (Duan et al., 2021). Kuang and Fu studied the impact of consumers' anticipated regret and whether retailers provide returns on online retailers' pricing decisions (Kuang & Fu, 2021). Zhou and Yuen studied the impact of consumer expected regret on corporate BBP strategy and profit. When consumers had a high regret rate of repeated purchases, companies should shift from rewarding new customers to rewarding customers who repeat purchases (Zhou & Yuen, 2021). These above research focuses on consumers' regret behavior in purchasing decisions on the entire supply chain.

Another issue related to the research in this paper is the different power structures of innovative product supply chain. Arslan et al. analyzed the impact of different product innovative strategies on enterprises' profits by establishing a game model between consumer and enterprise (Arslan et al., 2009; Koca et al., 2010). In response to the two-period game problem between continuously innovating enterprises and strategic consumers, Aviv and Pazgal analyzed the optimal innovation product strategy and pricing strategy of enterprises, and found that enterprises adopted 'Infiltration pricing strategy' and 'symbiotic replacement strategy', otherwise 'Rouge pricing strategy' and 'single product replacement strategy' should be adopted, when there are more high-end consumers and slower progress in social technology (Aviv & Pazgal, 2008). The above literatures mainly studied the game relationship between enterprises, but the difference in market power structure would also affect the price and replacement of products. For example, Gong analyzed the supply chain of manufacturer-led and retailer-led, and found that the efficiency of manufacturer-led structure is higher than the retailer-led structure's (Gong, 2013). By comparing the market leading structure of manufacturer and retailer, Lin and Cao found that the prices in the manufacturer-led market are lower in a multi-level supply chain system (Lin & Cao, 2014). From the perspective of suppliers' risk preference, Amin and Khojasteh discussed the model of manufacturers and retailers as Stackelberg leaders on the demand uncertainty (Amin-Naseri & Khojasteh, 2015). For the competitive remanufacturing supply chain, Gao et al. found that the decision makers under the price game would have the 'post-movement advantage' and the quantity game could have

the 'first move advantage' (Gao et al., 2016). Jin and Huang studied the influence of power structure on retailer's choice of brand differentiation strategy (Jin & Huang, 2021). Jin et al. studied the influence of different power structures on recycling pricing and coordination in closed-loop supply chain (Jin et al., 2021).The above studies show that different market power structures would significantly affect the operational efficiency of supply chain.

In summary, this paper analyzes the consumers' anticipated regret as a main irrational behavior on the innovative product strategy under different power structures, which could provide theoretical support for innovative supply chain management. Corresponding suggestions are provided for optimal pricing and win-win of supply chain members.

2. Problem description and demand function

A supply chain consisting of a retailer (indicated by subscripts R) and a manufacturer (indicated by subscripts M) is considered, where products are continuously innovative. There is only current product (defined a_1 as standard attribute) in the market, where the quality is 1 and the price is p_1. And innovative product is added innovation function attribute a_2, where the quality is q and the price is p_2, and the quality of new attribute is $q-1 \in (0,1)$.

Since consumers have a certain fear of regret which would have a negative effect, the disutility function of anticipated regret is expressed as (Jiang et al., 2017): $A.R. = -r_i \times prob(U_f > U_c) \times (U_f - U_c)$, where U_f is the net utility of giving up purchasing and U_c is the net utility of purchasing, and $prob(U_f > U_c)$ indicates the possibility of regret after purchasing and $r_i (i \in \{f, c\})$ is the regret sensitivity coefficient, which is used to measure the sensitivity of consumers' anticipated regret. Consumers may have different sensitive to choose to purchase or give up (Yin & Yu, 2009; Syam et al., 2008), this paper sets $r_c = r_f = r$ $(0<r<1)$. Therefore, if consumers buy the current product, there is a possibility k to regret, and the utility of giving up the current product is $u_1 = v - p_1$; the actual utility of purchasing the innovative product is $u_{2h} = \delta q v - p_2$, where δ is the depreciation rate and v is the consumers' willingness to pay for the unit quality of the current product.

For current product, and the willingness of each consumer is different, so assume that v is uniform distribution over interval $[0,1]$ (Liu & Zhang, 2017). Similarly, if consumers buy the innovative product, there is a possibility $1-k$ to regret, and the utility of giving up innovative product is $u_1 = v - p_1$; the actual utility of purchasing innovative product is $u_{2l} = \delta v - p_2$; therefore, consumers' utility functions of anticipated regret of purchasing current product and innovative product can be expressed as follows respectively: $U_1 = v - p_1 - kr(p_1 - v + \delta q v - p_2)$, $U_2 = (1-k)(\delta v - p_2) + k(\delta q v - p_2) - (1-k) r(v - p_1 + p_2 - \delta v)$. Similar to the description of Gao et al. (Gao et al., 2017; Örsdemir et al., 2014), consumers would purchase current product when $U_1 > U_2$ and $U_1 > 0$ are satisfied; and consumers would purchase innovative product when $U_2 > U_1$ and $U_2 > 0$ are satisfied. Demand functions are obtained:

$$D_1 = \left(\frac{1}{F_1} - \frac{kr}{-1 + krF_2}\right)p_2 - \left(\frac{1}{F_1} - \frac{1 + kr}{-1 + krF_2}\right)p_1$$
$$D_2 = 1 + \frac{p_1}{F_1} - \frac{p_2}{F_1} \tag{1}$$

Where D_1 is the demand function of the current product and D_2 is the demand function of the innovative product, $F_1 = \delta + k(q-1)\delta - 1$, $F_2 = \delta + (q-1)\delta - 1$.

3. Market power structure model construction

In the innovative supply chain, the retailer determines the retail price of current product and innovative product. The manufacturer determines the wholesale price of the current product and the innovative product. According to the different market structures, three supply chain models are considered which consisting of manufacturer and retailer as market leader and no market leader. According to the above demand function (1), the manufacturer's profit function π_M, retailer's profit function π_R and the utility functions of retailer and manufacturer can be expressed as:

$$\pi_M(w_1, w_2) = w_1 D_1 + w_2 D_2 \tag{2}$$

$$\pi_R(p_1, p_2) = (p_1 - w_1)D_1 + (p_2 - w_2)D_2 \tag{3}$$

$$U_R = \pi_R - \widehat{\lambda}_r \pi_M \tag{4}$$

$$U_M = \pi_M - \widehat{\lambda}_m \pi_R \tag{5}$$

Where $\widehat{\lambda}_m$ is the manufacturer's fairness preference coefficient and $\widehat{\lambda}_r$ is the retailer's fairness preference coefficient. Retailer and manufacturer may have different degree of fairness preference, but this paper sets $\widehat{\lambda}_m = \widehat{\lambda}_r = f$ and $0<f<1$ (Du et al., 2010).

3.1. Manufacturer-led model

Suppose that manufacturer has fairness preference behavior and is willing to pay high costs to maintain fairness. That means manufacturer would be willing to give up part of their profits and pursue fair profits based on their comprehensive consideration of their own strength and contribution, and then obtain a fairness utility. Solving by the backward induction, the first-order derivative of $\{p_1, p_2\}$ is obtained from the retailer's profit function (3), and the optimal response functions of the sales price are solved:

$$p_1^{M*} = \frac{F_1 kr\big(1 - kr(F_2 + w_1)\big) + (1 - F_2 kr)\big(2(1 + w_1) - kr(2F_2 + w_1 - w_2)\big)}{(4 - kr(4F_2 + F_1 kr))}$$
$$p_2^{M*} = \frac{\big(1 + F_1 + (F_1 - F_2)kr\big)\big(2 - kr(2F_2 + w_1)\big) - (2 + kr)(F_2 kr - 1)w_2}{(4 - kr(4F_2 + F_1 kr))} \tag{6}$$

Then, by taking functions (6) into the manufacturer's utility function (5), and the optimal wholesale price $\{w_1, w_2\}$ is solved by the first-order derivative:

$$\begin{aligned} w_1^{M*} &= \frac{(1+f)\big(1+(F_1-F_2)kr\big)}{2+f}, \\ w_2^{M*} &= \frac{(1+f)\big(1+F_1+(F_1-F_2)kr\big)}{2+f} \end{aligned} \tag{7}$$

The price and demand of the current product and innovative product, and the profit of manufacturer M and retailer R can be obtained. The specific results are shown in Table 1. See Appendix A1 for proof.

3.2. Retailer-Led model

In the retailer-led supply chain, the retailer would be willing to give up part of the profits to pursue fair profit on the basis of comprehensive consideration of its own strength and contribution. Solving by the backward induction, the manufacturer's profit function (2) is respectively obtained, and the reaction function of the wholesale price to the product price is obtained, which is brought into the function (4). Then the retailer's utility function is about $\{p_1, p_2\}$. The expressions of the optimal sales price $\{p_1, p_2\}$ are obtained by the first-order partial derivative. Finally, the expressions of wholesale price $\{w_1, w_2\}$ can obtained as follows:

$$\begin{aligned} w_1^{R*} &= \frac{1}{(2+f)}\frac{\big(2+(F_1-2F_2)kr\big)(1-F_2kr)}{4-kr(4F_2+F_1kr)}, \\ w_2^{R*} &= \frac{1}{(2+f)}\frac{2\big(1+F_1+(F_1-F_2)kr\big)(1-F_2kr)}{4-kr(4F_2+F_1kr)} \end{aligned} \tag{8}$$

The solution can be used to obtain the optimal wholesale price. The price and demand of the current product and innovative product, and the profit of manufacturer M and retailer R can be obtained. The specific results are shown in Table 1. Among them, similar to the above, the stagnation point is proved in which the model profit is maximized.

3.3. Non-leadership model

In this market, there is no leader. Manufacturer and retailer simultaneously determine appropriate $\{p_1, p_2\}$ and $\{w_1, w_2\}$ to maximize their own benefits. Similarly, the stagnation point is the point where the utility of the model is maximized can be verified. According to the utility functions (2) and (3), the optimal equilibrium results $\{p_1, p_2\}$ and $\{w_1, w_2\}$ are obtained:

$$\begin{aligned} p_1^{N*} &= \frac{2(1-F_2kr)\big(3-f+\big(2F_1-(3-f)F_2\big)kr\big)}{(3-f)^2-(3-f)^2F_2kr-2(1-f)F_1k^2r^2}, \\ p_2^{N*} &= \frac{2(3-f)\big(1+F_1+(F_1-F_2)kr\big)(1-F_2kr)}{(3-f)^2-(3-f)^2F_2kr-2(1-f)F_1k^2r^2} \end{aligned} \tag{9}$$

Table 1. Optimal decision-making of innovative product supply chain under the leadership of different market forces.

	Manufacturer leadership (M) model	Retail leadership (R) model	No leadership (N) mode
p_1^*	$\frac{1}{2+f}\frac{\begin{matrix}F_1kr(5-kr)(1-F_2kr)+6(1-F_2kr)^2-F_1^2k^3r^3\\+f(1+(F_1-F_2)kr)(4-kr(4F_2+F_1kr))\end{matrix}}{4-kr(4F_2+F_1kr)}$	$\frac{F_1kr(5-kr)(1-F_2kr)+6(1-F_2kr)^2-F_1^2k^3r^3}{(2+f)(4-kr(4F_2+F_1kr))}+\frac{f(1+(F_1-F_2)kr)}{(2+f)}$	$\frac{2(1-F_2kr)(3-f+(2F_1-(3-f)F_2)kr)}{(3-f)^2-(3-f)^2F_2kr-2(1-f)F_1k^2r^2}$
p_2^*	$\frac{1}{2+f}\frac{(1+F_1+(F_1-F_2)kr)\left(6+4f-kr\begin{pmatrix}2(3+2f)F_2\\+(f+1)F_1kr\end{pmatrix}\right)}{4-kr(4F_2+F_1kr)}$	$\frac{\begin{pmatrix}1+F_1+\\(F_1-F_2)kr\end{pmatrix}\begin{pmatrix}2(3+2f)(1-F_2kr)-\\(1+f)F_1k^2r^2\end{pmatrix}}{(2+f)(4-kr(4F_2+F_1kr))}$	$\frac{2(3-f)(1+F_1+(F_1-F_2)kr)(1-F_2kr)}{(3-f)^2-(3-f)^2F_2kr-2(1-f)F_1k^2r^2}$
w_1^*	$\frac{(1+f)(1+(F_1-F_2)kr)}{2+f}$	$\frac{(2+(F_1-2F_2)kr)(1-F_2kr)}{(2+f)(4-kr(4F_2+F_1kr))}$	$\frac{(1-F_2kr)(3-f+(2F_1-(3-f)F_2)kr)}{(3-f)^2-(3-f)^2F_2kr-2(1-f)F_1k^2r^2}$
w_2^*	$\frac{(1+f)(1+F_1+(F_1-F_2)kr)}{2+f}$	$\frac{2(1+F_1+(F_1-F_2)kr)(1-F_2kr)}{(2+f)(4-kr(4F_2+F_1kr))}$	$\frac{(3-f)(1+F_1+(F_1-F_2)kr)(1-F_2kr)}{(3-f)^2-(3-f)^2F_2kr-2(1-f)F_1k^2r^2}$
D_1^*	$\frac{1}{2+f}\frac{kr(1+F_1+(F_1-F_2)kr)}{4-kr(4F_2+F_1kr)}$	$\frac{kr(1+F_1+(F_1-F_2)kr)}{(2+f)(4-kr(4F_2+F_1kr))}$	$\frac{2(1-f)kr(1+F_1+(F_1-F_2)kr)}{(3-f)^2-(3-f)^2F_2kr-2(1-f)F_1k^2r^2}$
D_2^*	$\frac{1}{2+f}\frac{2-kr(1+2F_2+(F_1-F_2)kr)}{4-kr(4F_2+F_1kr)}$	$\frac{2-kr(1+2F_2+(F_1-F_2)kr)}{(2+f)(4-kr(4F_2+F_1kr))}$	$\frac{(1-f)\left(3-f(1-F_2kr)-kr\begin{pmatrix}2+3F_2+\\2(F_1-F_2)kr\end{pmatrix}\right)}{(3-f)^2-(3-f)^2F_2kr-2(1-f)F_1k^2r^2}$
π_R^*	$\frac{1}{(2+f)^2}\frac{(1+F_1+(F_1-F_2)kr)(1-F_2kr)}{(4-kr(4F_2+F_1kr))}$	$\frac{2(1+f)(1+F_1+(F_1-F_2)kr)(1-F_2kr)}{(2+f)^2(4-kr(4F_2+F_1kr))}$	$\frac{(1-f)(1+F_1+(F_1-F_2)kr)(1-F_2kr)}{(3-f)^2-(3-f)^2F_2kr-2(1-f)F_1k^2r^2}$
π_M^*	$\frac{2(1+f)}{(2+f)^2}\frac{(1+F_1+(F_1-F_2)kr)(1-F_2kr)}{(4-kr(4F_2+F_1kr))}$	$\frac{(1+F_1+(F_1-F_2)kr)(1-F_2kr)}{(2+f)^2(4-kr(4F_2+F_1kr))}$	$\frac{(1-f)(1+F_1+(F_1-F_2)kr)(1-F_2kr)}{(3-f)^2-(3-f)^2F_2kr-2(1-f)F_1k^2r^2}$

Source: drew by authors.

$$w_1^{N*} = \frac{(1-F_2kr)\left(3-f+\left(2F_1-(3-f)F_2\right)kr\right)}{(3-f)^2-(3-f)^2F_2kr-2(1-f)F_1k^2r^2},$$
$$w_2^{N*} = \frac{(3-f)\left(1+F_1+(F_1-F_2)kr\right)(1-F_2kr)}{(3-f)^2-(3-f)^2F_2kr-2(1-f)F_1k^2r^2} \tag{10}$$

And the price and demand of current product and innovative product in the N model, and the profit of the manufacturer M and the retailer R can be obtained. The specific results are shown in the Table 1.

4. Model results analysis

This section the results of different market power models in detail are analyzed and the following propositions are obtained:

Proposition 1 : According to the above models comparison analysis, if $q \geq \frac{1-\delta+k\delta}{k\delta}$, there are $p_2^{M*} \geq p_1^{M*}$, $p_2^{R*} \geq p_1^{R*}$, $p_2^{N*} \geq p_1^{N*}$ and $w_2^{M*} \geq w_1^{M*}$, $w_2^{R*} \geq w_1^{R*}$, $w_2^{N*} \geq w_1^{N*}$.

The proposition shows that, when the product innovation attribute exceeds the threshold value, the wholesale price and sales price of the innovative product would be higher than that of the current product, this proposition can provide guidance for the enterprises' pricing decision of the innovative product. For example, every time Apple releases a new product, the prices of new product and old product remain almost unchanged. Otherwise, price increases can reduce the demand for innovative products.

Proposition 2: According to the comparison of the different market power structure models: (1) p_1^* and p_2^* are negatively correlated with r, w_1^* and w_2^* are negatively correlated with r; (2) D_1^* is positively correlated with r and D_2^* is negatively correlated with r, and $D_1^* + D_2^*$ is positively correlated with r; (3) π_M^*, π_R^* and π_S^* are negatively correlated to r.

The proposition shows that: (1) In the innovative supply chain of the three leadership structures, as consumers become more sensitive to anticipated regret, the sales price and wholesale price of current product and innovative product on the market would decrease. Because the anticipated regret would reduce the consumers' utility, when the retailer clearly perceives that the consumers' purchasing desire declines, 'penetration pricing strategy' or 'discount promotion strategy' are adopted to stimulate the demand to reduce sales risk. (2) When the anticipated regret sensitivity of consumers is relatively high, product sales price is reduced, more consumers are attracted to purchase in advance, while the quantity of innovative product is reducing. As consumers become more uncertain about the innovative product attributes, and the price of current product is lower than the price of innovative product, which makes part of consumers transfer to current product, causing the demand of current product to increase and the demand of innovative product to decline. At this time, enterprises should engage in 'quick innovation strategy' to attract consumers (Dhebar, 1994; 3) As the sensitivity of anticipated regret increases, the manufacturer's profit, the retailer's profit and the total profit of supply chain would decrease. It is found that the higher the sensitivity of consumers' anticipated regret, the more

adverse the supply chain is. In addition to 'rapid innovation strategy', enterprises can adopt 'promised advertising strategy' to change consumers' anticipated regret sensitivity. For example, in March 2018, Su Ning promised 'In offline stores, consumers can return goods without reason' to attract a large number of consumers.

Proposition 3: By comparing and analyzing the supply chain of different market leadership structures, it is found that: (a) p_1^* and p_2^* are positively correlated with f; (b) D_1^* and D_2^* are negatively correlated with f; (c) π_M^*, π_R^* and π_S^* are negatively correlated with f.

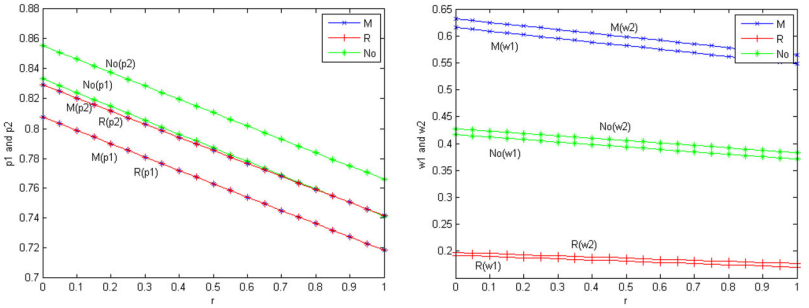
The proposition shows that: (1) As the level of fairness preference increases, the sales price of current product and innovative product in the market would increase, because enterprises with fairness preference would increase the sales price when their profits decrease. Therefore, when the profits of other enterprises in the supply chain are taken into consideration, the 'value-added strategy' can be adopted to encourage other enterprises to add profit channels, thereby increasing the product price in a disguised form and achieving 'win-win'. For example, Taobao's 'door-to-door installation service' can not only bring convenience to consumers, but also properly increases the income of retailers and manufacturers. (2) When the level of fairness preference is relatively high, enterprises are worried about the reduction of their utility. In order to obtain their own profits, they would increase the sales price, and thus the expected demand for products would decline. At this time, member enterprises in the supply chain should strengthen communication and cooperation and establish stable 'strategic partnership'. (3) Manufacturer's profit, retailer's profit and total profit of supply chain all would decrease with the increase of fairness preference. It is found that a higher degree of fairness preference is more detrimental to the product supply chain. Therefore, enterprises should adopt 'value-added strategy' to promote consumption and bring additional benefits while 'innovating rapidly'. In addition, the manufacturer and retailer should maintain good communication and establish long-term cooperative relations.

5. Example analysis

On the basis of theoretical analysis, this chapter uses MATLAB software to construct numerical simulation, further study the influence of various factors on different leadership structures supply chain, intuitively examine those conclusions. The initial parameters are set as follows: $r = 0.7,\ \delta = 0.7,\ k = 2/3,\ q = 1.7,\ f = 0.6$.

5.1. Consumers' anticipated regret analysis

Consumers' anticipated regret would affect consumers' acceptance of the products, which has an important impact on the supply chain. In order to further investigate intuitively, the change curves of sales price, wholesale price, quantity demanded, and system profit under different market leadership structures are respectively drawn within the range of consumers' anticipated regret $r \in [0, 1]$, as shown in Figures 1–3.



(a) (b)

Figure 1. The impact of consumers' anticipated regret on the sale price and wholesale price.
Source: drew by authors.

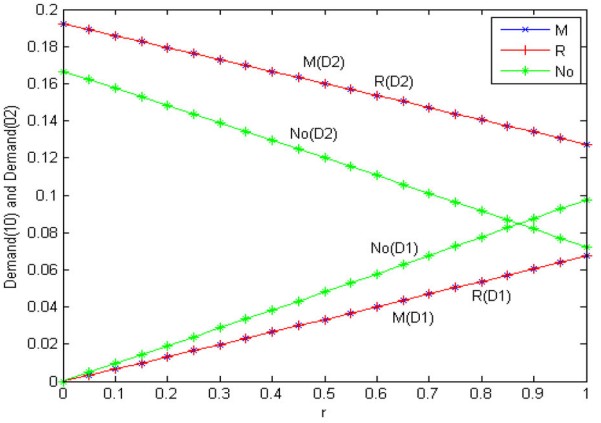
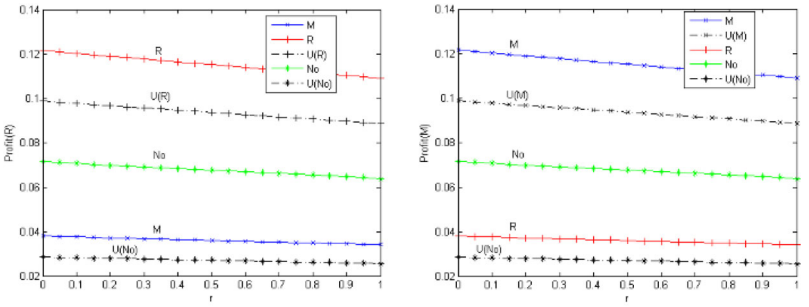


Figure 2. The impact of consumers' anticipated regret on the demand.
Source: drew by authors.



(a) (b)

Figure 3. The impact of consumers' anticipated regret on the profit of supply chain.
Source: drew by authors.

1. As can be seen from Figure 1, under different market leadership structures, the sales price and wholesale price of current product and innovative product all decrease with the increase of consumers' anticipated regret degree. For high level of consumers' anticipated regret, enterprises can adopt 'low price strategy' to

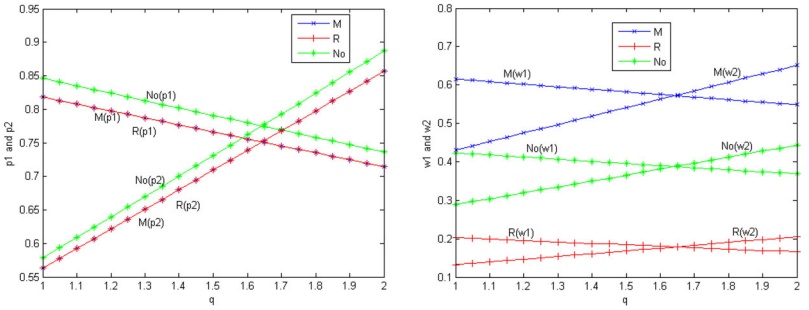


Figure 4. The impact of new attribute on the sale price and wholesale price.
Source: drew by authors.

attract customers. And it can be seen that the price of innovative product is always slightly higher than the price of current product, which indicates that when the degree of consumers' anticipated regret changes, innovative product is still attractive to consumers. And the sales price in markets with leader is lower, which is more beneficial to consumers.

2. As can be seen from Figure 2, the demand for current product increases with the increase of consumers' anticipated regret, and the model with no leader increases faster than the model with leader. The demand for innovative product decreases with the increase of consumers' anticipated regret, and the model with no leader also decreases faster than the model with leader. Especially when $r>0.8717$, in the market with no leader, the demand for current product would exceed the demand for innovative product. However, by comparing the sum of the demand for current product and innovative product, the total demand increases slowly with the increase of the anticipated regret, which indicates that the consumers' anticipated regret would affect the purchase decision, but would not completely block the increase of the total demand for products.
3. As can be seen from Figure 3, the manufacturer's profit, the retailer's profit and the entire supply chain's profit decrease with the increase of consumers' anticipated regret, including $\pi_M^{*M} \geq U_M^{*M} \geq \pi_M^{*N} \geq \pi_M^{*R} \geq U_M^{*N}$ and $\pi_R^{*R} \geq U_R^{*R} \geq \pi_R^{*N} \geq \pi_R^{*M} \geq U_R^{*N}$, which indicates that the leader can get more profits and would stimulate more enterprises to occupy the dominant position by developing rapidly in the supply chain. Besides it can also be seen that $\pi_R^{M*} + \pi_R^{R*} = \pi_M^{R*} + \pi_M^{M*} \geq \pi_M^{N*} + \pi_R^{N*}$. Obviously, with the increase of the consumers' anticipated regret, the total profit is reduced faster than the enterprises' profit. And the models with leader are more effective when considering fairness preference.

5.2. Quality analysis of innovation attributes

Because this paper takes the innovative supply chain as the research object, in order to further visually research the influence of the innovative attributes of products on consumers and supply chain, the change curves of product sales price, wholesale price, demand and system profit under different market structures in innovation attribute $q \in [1, 2]$ are respectively drawn, as shown in Figures 4–6.

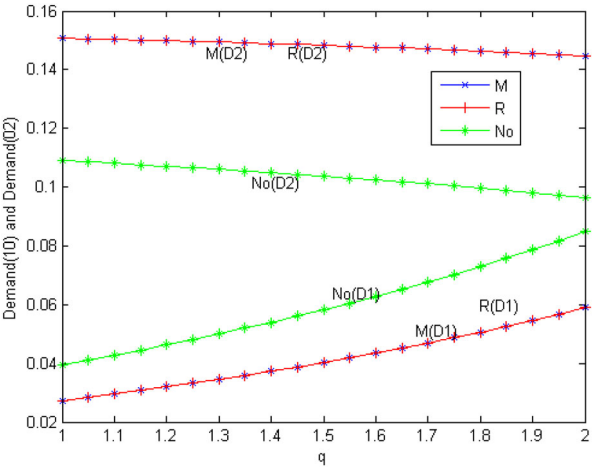


Figure 5. The impact of new attribute on the demand.
Source: drew by authors.

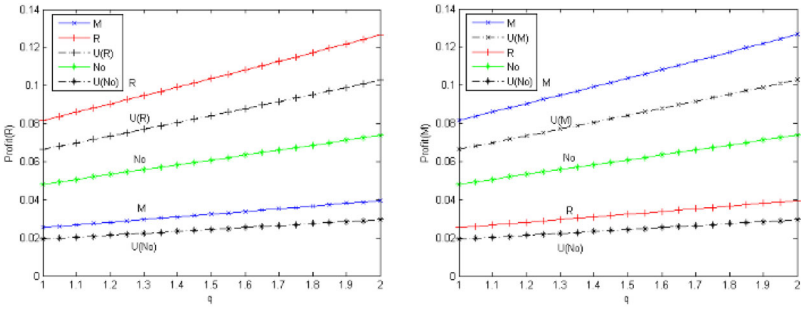


Figure 6. The impact of new attribute on the profit of supply chain.
Source: drew by authors.

1. As can be seen from Figure 4, the sales price of the current product decreases with the increase of the innovation attributes, but the wholesale price increases with the increase of the innovation attributes. The sales price of the innovative products increases with the increase of the innovation attributes, but the wholesale price decreases with the increase of innovation attributes, and the rate of increase is significantly faster than the rate of decrease, which indicates that the quality of innovation attributes would increase competition among products. When the value of innovation is at the threshold of $q \geq 1.6429$, the sales price and wholesale price of the innovative product are higher than the sales price and wholesale price of the current product, which indicates that only when the innovation attributes value of the products increases to the critical point, the enterprise can adopt 'skimming pricing strategy' for the innovative product.
2. As can be seen from Figure 5, the demand of current product increases with the increase of innovation attributes, while the demand of innovative product decreases with the increase of innovation attributes. However, the greater increase in demand for innovative product can be clearly seen in Figure 5, so the total

demand increases with the increase of innovation attributes. Above situation shows that for innovative product, when an enterprise increases its innovation attributes, this means increased costs which would affect the sales price. High sales price would reduce the utility of consumers on innovative product and thus reduce the market share of innovative product. Therefore, an enterprise should adopt the 'appropriate innovation strategy' to maintain the sustainable development of the enterprise.

3. As can be seen from Figure 6, the member's profit and system's profit in the supply chain increase with the increase of the innovation attributes. The leader can obtain more profits, and the structures with leader is more efficient. It explains that innovation can bring more profits to the supply chain, and continuous innovation has always been the core driving force for enterprise development.

6. Conclusion

By comparing and analyzing the effects of consumers' anticipated regret and innovation attributes quality on innovative supply chain under different market leaderships. The research shows that: (1) When the innovative attributes of the product reach the threshold, the innovative product adopts the 'skimming pricing strategy'; in order to maintain the sustainable and stable development of the company, the 'moderate innovation strategy' should be adopted. (2) The demand for innovative product decreases with the increase of regret level, and the non-leadership market decreases faster than the leadership market. The consumers' anticipated regret would not block the increase of total demand. (3) Regardless of the leadership market, the sales price increases as fairness preference increases. With the increase of fairness preference, the total profit of the supply chain is reduced faster than that of the enterprises' profit.

This paper can carry out follow-up research from the following aspects: (1) Further consider different anticipated regret coefficients of current product and innovative product; (2) Further consider the anticipated regret for discounted and innovative products.

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References

Amin-Naseri, M., & Khojasteh, M. A. (2015). Price competition between two leader–follower supply chains with risk-averse retailers under demand uncertainty. *The International Journal of Advanced Manufacturing Technology*, *79*(1-4), 377–393. https://doi.org/10.1007/s00170-014-6728-0

Arslan, H., Kachani, S., & Shmatov, K. (2009). Optimal product introduction and life cycle pricing policies for multiple product generations under competition. *Journal of Revenue and Pricing Management*, *8*(5), 438–451. https://doi.org/10.1057/rpm.2008.47

Aviv, Y., & Pazgal, A. (2008). Optimal pricing of seasonal products in the presence of forward-looking consumers. *Manufacturing & Service Operations Management*, *10*(3), 339–359. https://doi.org/10.1287/msom.1070.0183

Boudreau, J., Hopp, W., McClain, J. O., & Thomas, L. J. (2003). On the interface between operations and human resources management. *Manufacturing & Service Operations Management*, *5*(3), 179–202. https://doi.org/10.1287/msom.5.3.179.16032

Croson, R., & Donohue, K. (2002). Experimental economics and supply-chain management. *Interfaces*, *32*(5), 74–82. https://doi.org/10.1287/inte.32.5.74.37

Dhebar, A. (1994). Durable-goods monopolists, rational consumers, and improving products. *Marketing Science*, *13*(1), 100–120. https://doi.org/10.1287/mksc.13.1.100

Diecidue, E., Rudi, N., & Tang, W. (2012). Dynamic purchase decisions under regret: Price and availability. *Decision Analysis*, *9*(1), 22–30. https://doi.org/10.1287/deca.1110.0227

Du, S. F., Du, C., & Liang, L. (2010). Supply chain coordination considering fairness preferences. *Journal of Management Sciences in China*, *13*, 41–48.

Duan, Y. R., Xu, C., & Liu, J. J. (2021). Pricing and quality policies for innovated products with consumers'anticipated regret. *Industrial Engineering and Management*, *26*, 185–194.

Feng, L., & Han, Y. (2019). Impact of consumer behavior on new product diffusion under Duopoly market: A simulation approach. *Industrial Engineering Journal*, *22*, 8–16 + 26.

Gao, P., Du, J., Nie, J., & Lu, Y. (2017). Impact of consumer's anticipated regret on power structure of competitive remanufacturing supply chain. *Chinese Journal of Management Science*, *25*, 78–87.

Gao, P., Nie, J. J., & Lu, Y. M. (2016). Research on the quality decision on the competitive remanufacturing supply chain under different market leader. *Journal of Industrial Engineering and Engineering Management*, *30*, 187–195.

Gong, Y. D. (2013). Effect of dominant mode and recovery subsidies on closed-loop supply chain decision, stability and efficiency. *Control and Decision*, *28*, 1263–1272.

Huang, L. Q., & Zhang, G. L. (2021). Research on strategic consumer innovation perception and product pricing and rollover strategy. *Chinese Journal of Management Science*, *29*, 89–98.

Jiang, B., Narasimhan, C., & Turut, Ö. (2017). Anticipated regret and product innovation. *Management Science*, *63*(12), 4308–4323. https://doi.org/10.1287/mnsc.2016.2555

Jin, L., & Huang, X. M. (2021). Optimal pricing and product differentiation strategy under different price leadership. *Management Review*, *32*, 205–216.

Jin, L., Zheng, B. R., & Huang, S. J. (2021). Pricing and coordination in a reverse supply chain with online and offline recycling channels: A power perspective. *Journal of Cleaner Production*, *298*, 126786. https://doi.org/10.1016/j.jclepro.2021.126786

Katok, E., & Pavlov, V. (2013). Fairness in supply chain contracts: A laboratory study. *Journal of Operations Management*, *31*(3), 129–137. https://doi.org/10.1016/j.jom.2013.01.001

Koca, E., Souza, G. C., & Druehl, C. T. (2010). Managing product rollovers. *Decision Sciences*, *41*(2), 403–423. https://doi.org/10.1111/j.1540-5915.2010.00270.x

Kuang, Y. J., & Fu, K. (2021). Inventory and consumer returns policies under consumers'anticipated regret. *Journal of Management Sciences in China*, *24*, 69–85.

Lin, J., & Cao, K. (2014). Pricing models of closed-loop supply chain in double channels competitions environment. *Systems Engineering-Theory & Practice*, *34*, 1416–1424.

Liu, W. Q., & Zhang, J. J. (2017). Study on product rollover strategies with consumers' anticipated regret. *China Soft Science*, *1*, 147–156.

Niu, W. J., & Xia, J. (2021). Product Innovation and Pricing Strategies in the Presence of Strategic Consumers. *Operations Research and Management Science*, *30*, 154–160.

Örsdemir, A., Kemahlıoğlu-Ziya, E., & Parlaktürk, A. K. (2014). Competitive quality choice and remanufacturing. *Production and Operations Management*, *23*(1), 48–64. https://doi.org/10.1111/poms.12040

Plambeck, E., & Wang, Q. (2009). Effects of e-waste regulation on new product introduction. *Management Science*, *55*(3), 333–347. https://doi.org/10.1287/mnsc.1080.0970

Rao, S., Rabinovich, E., & Raju, D. (2014). The role of physical distribution services as determinants of product returns in Internet retailing. *Journal of Operations Management*, *32*(6), 295–312. https://doi.org/10.1016/j.jom.2014.06.005

Syam, N., Krishnamurthy, P., & Hess, J. D. (2008). That's what I thought I wanted? Miswanting and regret for a standard good in a mass-customized world. *Marketing Science*, *27*(3), 379–397. https://doi.org/10.1287/mksc.1070.0302

Wang, W. B., Da, Q. L., & Nie, R. (2011). The study on pricing and coordination of closed-loop supply chain considering channel power structure. *Chinese Journal of Management Science*, *5*, 29–36.

Yin, C. Y., & Yu, H. Y. (2009). The impact of anticipated regret on consumer impulse buying behavior. *Management Review*, *30*, 187–195.

Zhou, Q., & Yuen, K. F. (2021). Behavior-based pricing: an analysis of the impact of anticipated regret. *INFOR: Information Systems and Operational Research*, *59*, 517–546.