Research on Consumer Risk Perception and Trust Transmission between Channels

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Abstract

This paper establishes a mathematical model of trust transmission between channels based on the theoretical foundation of empirical research on online consumer trust. Consider that a manufacturer sells products offline through an independent retailer. In contrast, the manufacturer expands offline products to direct online channels and establishes trust transmission between offline and online channels to achieve channel synergy. In channel pricing, the full price theory of the channel is used to establish a model to study the trust transmission between channels. Based on the perceived risks of online and offline consumers, the issue of trust transmission and pricing between channels is investigated. Taking the online consumer trust of channel expansion as the object, constructing the consumer utility function under the influence of perceived risk and the degree of online trust, and establishing the Stackelberg game model. The relationship between channel pricing, online trust level, and the main determinants of trust transmission between channels are discussed. The research results show that the increase in online trust leads to a decrease in offline pricing, a decrease in offline demand, and an increase in online demand, and the profits of manufacturers increase while the profits of retailers decrease. Also, manufacturers' efforts to transmit trust in online channels decrease with the increase in offline product performance fluctuations, decrease with the increase in trust transmission cost coefficient, and increase with the increase in offline and online cost gaps.

Keywords: Consumer behavior, Risk perception, Trust level, Channel

1. Introduction

In the context of new retail, online companies, offline traditional consumer goods retail companies, and various cross-border corporate giants are actively trying to expand retail channels and form a sales model that combines multiple channels. Online shopping has time and price advantages, but consumers' perceived risk is still high compared to physical stores. The lack of sufficient consumer trust is currently the biggest obstacle to the development of online transactions [1]. Consumers' shopping channel choice is often a trade-off between product price, shopping time, delivery time, and perceived risk. Their willingness to pay for different channels is a function of time, convenience, and risk cost and depends on the characteristics of consumer preferences [2]. Consumer behavior determines the choice of shopping channels, and personal risk-taking behavior often depends on their perception of risk and the degree of risk acceptance [3], so the risk will affect consumer shopping channel

selection behavior. Consumers feel risk in most purchase decisions, and risk perception greatly affects consumer purchase decisions, leading to changes, delays, or abandonment of purchases [4][5]. The inherent intangibility of the online environment and face-to-face contact with a non-personnel lead to greater consumer perceived risks. When there is uncertainty in products or services, consumers with low-risk aversion prefer online shopping, while consumers with high-risk aversion prefer physical stores [6]. In addition to providing convenient purchasing methods and preferential prices for online companies, how to meet consumers' psychological needs is more important.

Some scholars have found that because trust positively impacts consumers, it can be used as an effective risk-reduction mechanism [7][8]. Trust in online shopping continues to grow, but it is still low relative to offline sales [9]. The key way to solve this online trust establishment problem is trust transfer, which builds a positive perception of the integrity of online stores through trust in physical stores that consumers are familiar with. The combination of online and offline channels can use physical storefronts to save costs in terms of warehousing, transportation, and distribution. More importantly, it can use the trust established by consumers in offline physical stores to solve online consumers' lack of trust and perceived risk. For most online transactions, it is more difficult to gain user trust. Online companies with offline businesses have certain advantages in enhancing consumer trust. For offline companies, the problem they face when expanding online channels is whether the trust of offline consumers accumulated over the years can be transferred to consumers' good perception of online products.

The literature on online trust mainly verifies the determinants of trust establishment from an empirical point of view and the influence of individual factors on trust transfer [9]. McKnight and Chervany [11] classified trust in the online context and identified the three dimensions of online trust, namely, preference trust (such as general trust tendency), system-based trust (such as trust in the Internet environment), and Interpersonal trust (such as trust in online product suppliers). Stewart [12] studied the influence of links between multiple websites on trust transfer between websites in an online context. The study believes that the more mutual links between websites, the higher the relevance and quality of the links, and the more significant the phenomenon of trust transfer. Through empirical research, Kuan and Bock [13] revealed that consumers' trust in retailers' offline businesses will enhance their trust in online businesses. Kuan and Bock believe that consumers will rely on the consumption experience of online retailers' physical stores to build trust, and offline trust, social network word-of-mouth, and expected sanctions against merchants' breaches of trust are the most significant factors in establishing online consumer trust. [14]Through empirical research, Lee et al. [14] verified that consumers' trust in offline banks will affect their adoption of bank online business. It is proposed that trust in offline banks will directly affect online banking from four aspects: structural guarantee, liquidity, perceived website satisfaction, and perceived usage. Bock et al. [15] evaluated the influencing factors of online trust of multi-channel retailers at different stages. They empirically revealed the transfer of trust of multi-channel retailers from offline to online channels. Literature [16] puts forward a model of influencing factors of online retail consumption willingness based on trust theory and perceived risk. It empirically reveals the relationship between online retailers' brand image, sales management, service quality, technical safety, and consumers' trust tendency and perceived risk. Literature [17] regards the dealer as the first customer of the enterprise and explores the mechanism of customer trust and transfer barriers on customer retention in the B2B scenario through case studies. Literature [19] discussed the process of trust restoration after channel member conflicts, analyzed the influence of different restoration strategies

(cooperative strategies and competitive strategies) on trust restoration, and tested the mediating role of perceived fairness (procedural fairness and distribution fairness). Literature [20] empirically studies the influence of unfair and speculative behavior in cooperation channels based on a destructive perspective. It analyzes the mediating role of organizational trust and conflict in the above effects.

The literature that studies trust transfer between channels mainly verifies the positive effect of offline channel consumer trust on the establishment of online trust from an empirical point of view and the main determinants of online trust establishment. Similar to offline interaction, online transactions' trust goal is also to present consumers with trustworthy objects [21]. Online organizations must strive to improve their reputation, performance, and interface design to establish themselves as trustworthy objects. At the same time, online consumers evaluate the trustworthiness of their online transaction objects based on standards of competitiveness, ethics, and integrity. In addition, the issues that companies will also be involved in channel expansion include: How will the differences in consumer perception of risks between online and offline shopping methods affect channel pricing? How does the establishment of trust affect the pricing of channel products? How do we influence consumers' choices of shopping methods? In the process of trust transfer from offline to online, how much effort does the manufacturer put into establishing the trust of online consumers and reducing the perceived risk? What factors affect the level of trust transmission between channels? This paper establishes a mathematical model of trust transmission between channels based on the theoretical foundation of predecessors' empirical research on online consumer trust. Consider that a manufacturer sells products offline through an independent retailer. In contrast, the manufacturer expands offline products to direct online channels and establishes trust transmission between offline and online channels to achieve channel synergy. In channel pricing, the full price theory of channels [22] is used to establish a model to study the issue of trust transmission between channels and to discuss the above issues.

2. Consumer risk perception and trust transfer model and assumptions

Manufacturers sell products through both online and offline channels, and offline sales of products in physical stores through retailers; at the same time, manufacturers establish online sales channels to sell products directly online. Due to the low overall authenticity rate of electronic channels, although the products sold by manufacturers online are authentic, consumers feel that the risk is higher because they cannot touch the physical products during shopping. That is, the perceived risk is higher. Let $U(I)$ denote the consumer's utility function at the time of the current property (that is, what to do to buy). The consumer utility function is assumed to be a constant relative risk aversion (CARA). Let v denote the consumer's risk appetite. The Arrow-Pratt measurement of this risk aversion is $v = -\frac{U''(I)}{U'(I)} = -\frac{d\ln U'(I)}{dI}$. The corresponding exponential utility function is $U(I) = -e^{-vI}$。

When consumers shop in offline physical stores, the benefits obtained through product purchase $B = \theta \pm \sigma$, θ is the expected benefit of consumers buying this product, and σ is the fluctuation of benefit, which depends on the stability of product quality and function—the more stable the product quality function, the smaller the σ. Due to risk aversion, consumers will have perceived risk $(v/2) \cdot \sigma^2$ during the purchase process. Given that the products sold online and offline are the same, but because consumers cannot access the actual products during online consumption and transactions are completed through humans and machines, their perceived risks are greater. The perceived risk is $(v/2) \cdot (\sigma/\gamma)^2$ for consumers. Among them, γ is the trust transfer coefficient of offline to online products formed when

manufacturers expand their products from offline to online channels. Since consumers of online products cannot directly experience products and services, online transactions aggravate consumer risks. Therefore, given here $\gamma \in (0,1)$, consumers will think about psychological perception during online shopping. Compared with the offline shopping method, it takes a greater risk. The greater the trust transfer coefficient, the more effective the establishment of trust transfer from offline to online enterprise products and the lower consumers' perceived risk during online shopping.

As online shopping consumers face greater perceived risks, only consumers with a relatively low degree of risk aversion will purchase products through online channels [22]. If $v_2 > v_1$, a consumer with a risk preference factor of v_2 will show greater risk aversion than a consumer with a risk preference factor of v_1. Marginal consumers are equally effective in purchasing products online and offline. When $U_r > U_d$, using the deterministic equivalence method, when the risk premium is included, the critical point for the equal utility of the two methods is $\theta - \frac{v_1}{2}\sigma^2 - p_r = \theta - \frac{v_1}{2}(\frac{\sigma}{\gamma})^2 - p_d$. Where p_r is the price of the company's offline product; p_d is the price of the company's online product. Simplify the above expression, get

$$v_1 = 2\gamma^2 \frac{p_r - p_d}{(1 - \gamma^2)\sigma^2}$$

where, when $v < v_1$, there must be $U_r < U_d$ and the consumer's risk aversion degree is not high. Due to the lower online price, the utility of online shopping will be greater than the utility of offline shopping. Therefore, consumers purchase online in the interval [0, v1].

When the degree of risk aversion is greater than v_1, at this time $U_r > U_d$, consumers choose offline shopping, and when it reaches, the utility of buying products and not buying is equivalent, Ur=U0=0, get $\theta - p_r - \frac{v_2}{2}\sigma^2$, so you can get $v_2 = \frac{2(\theta - p_r)}{\sigma^2}$. The total product demand interval is $[0, v_2]$, That is

$$\mu = v_2 = \frac{2(\theta - p_r)}{\sigma^2} \tag{1}$$

Equation (1) means that the demand for a product not only depends on its utility θ and the selling price p_r but is also affected by the product quality: the smaller σ, the more stable the product quality, and the greater the corresponding product demand μ, and vice versa The smaller the demand. This is very consistent with reality. Therefore, the online channel demand is

$$q_d = v_1 = 2\gamma^2 \frac{p_r - p_d}{(1 - \gamma^2)\sigma^2} \tag{2}$$

The demand for offline channels is

$$q_r = v_2 - v_1 = 2\frac{(1 - \gamma^2)\theta - p_r + \gamma^2 p_d}{(1 - \gamma^2)\sigma^2} \tag{3}$$

Assume that the unit cost of offline sales is c_r, and the unit cost of online sales is $c_r > c_d$. That is, offline sales face greater costs. In the process of trust transmission between product channels, much effort or investment is required, including effective publicity, consumer behavior guidance, a large amount of advertising investment, and so on. Please assume that the cost paid by the manufacturer for online trust establishment is $C = I/(1 - \gamma^2)$, where γ is the product trust transfer coefficient, and I is the trust transfer cost coefficient. The greater the

coefficient of trust transfer cost, the more difficult it is to establish consumers' trust from offline to online, the greater the effort required, and the greater the cost. Therefore, the profit of offline channel retailers is

$$\pi_r = (p_r - w - c_r) \cdot 2\frac{(1-\gamma^2)\theta - p_r + \gamma^2 p_d}{(1-\gamma^2)\sigma^2} \tag{4}$$

The manufacturer's profit is

$$\pi_m = w \cdot 2\frac{(1-\gamma^2)\theta - p_r + \gamma^2 p_d}{(1-\gamma^2)\sigma^2} + (p_d - c_d) \cdot 2\gamma^2 \frac{p_r - p_d}{(1-\gamma^2)\sigma^2} - \frac{I}{1-\gamma^2} \tag{5}$$

The decision sequence is as follows. In the first stage, the manufacturer determines the degree of trust transfer between channels γ. In the second stage, manufacturers and retailers conduct price games within channels to determine channel pricing. In the channel price decision, the manufacturer first determines the offline channel wholesale price w and the online channel product price p_d, and the retailer determines the offline channel product retail price p_r.

3. Pricing decision

Under the condition that the degree of trust transmission between channels γ is established, the second-stage manufacturer and the retailer conduct a channel price game. Given that the upstream manufacturer determines the offline wholesale price w and the online price p_d of the product, the retailer determines the product line. The retail price is p_r to maximize its profit, that is, $p_r^* = argmax\pi_r(p_r)$. From equation (4), the first-order condition of retailer's profit on pricing, which is $d\pi_r/dp_r = 0$, get$\frac{d\pi_r}{dp_r} = 2 \cdot \frac{(1-\gamma^2)\theta - 2p_r + w + c_r + \gamma^2 p_d}{(1-\gamma^2)\sigma^2}$. Given w and p_d for downstream retailers, the offline price of the product is

$$p_r = \frac{(1-\gamma^2)\theta + \gamma^2(c_d + p_d) - c_r + w}{2} \tag{6}$$

Substituting p_r into formula (5), the manufacturer's profit function, we get

$$\pi_m = w \cdot \frac{(1-\gamma^2)\theta - w - c_r + \gamma^2 p_d}{(1-\gamma^2)\sigma^2} + (p_d - c_d) \cdot \gamma^2 \frac{(1-\gamma^2)\theta + w + c_r - (2-\gamma^2)p_d}{(1-\gamma^2)\sigma^2} \tag{7}$$

According to formula (7), the manufacturer's profit is the first-order condition of product offline retail pricing w and product online pricing p_d respectively, that is $\frac{d\pi_m}{dp_d} = 0$, get

$$\frac{d\pi_m}{dw} = \frac{(1-\gamma^2)\theta - 2w - c_r + \gamma^2 p_d}{(1-\gamma^2)\sigma^2} + \frac{(p_d - c_d)\cdot\gamma^2}{(1-\gamma^2)\sigma^2} \tag{8}$$

$$\frac{d\pi_m}{dp_d} = \frac{\gamma^2 w}{(1-\gamma^2)\sigma^2} + \gamma^2 \frac{(1-\gamma^2)\theta + w + c_r - (2-\gamma^2)(2p_d - c_d)}{(1-\gamma^2)\sigma^2} \tag{9}$$

Simultaneous formula (8) and formula (9), get $p_d^* = \frac{\theta + c_d}{2} w^* = \frac{\theta - c_d}{2}$, Get from p_d^* and w^*

$$p_r^* = \frac{(3-\gamma^2)\theta + c_r + \gamma^2 c_d}{4} \tag{10}$$

Proposition 1. The product's offline retail price p_r^* decreases with the trust transfer coefficient γ increase.

Prove: From equation (10) p_r^* Derivation of the trust transfer coefficient γ can be obtained $\frac{dp_r^*}{d\gamma} = \frac{-2\gamma\theta + 2\gamma c_d}{4}$, and because where $\theta > c_d$, from this you can get $\frac{dp_r^*}{d\gamma} < 0$, Proposition 1 is proved.

Proposition 1 shows that in the process of simultaneous offline and online dual-channel product sales if the offline to online trust transfer coefficient is large, it indicates that consumers have less perceived risk of online sales of the company, which is beneficial to the company at this time Online product sales. Then, among the online and offline choices, some consumers tend to choose online shopping. Since retailers set offline retail prices, they must lower prices to maintain competition with online channels. Consumers' perceived risk is relatively small when they choose offline shopping. When the online trust of the product is successfully established, and consumers' perceived risk can be reduced, this will inevitably squeeze the profit space of offline retailers—forcing them to reduce product prices.

Substituting further, we can get the product online channel demand in equilibrium as

$$q_d^* = \gamma^2 \frac{(1-\gamma^2)\theta + c_r - (2-\gamma^2)c_d}{2(1-\gamma^2)\sigma^2} \tag{11}$$

Offline demand is

$$q_r^* = \frac{(1-\gamma^2)\theta - c_r + \gamma^2 c_d}{2(1-\gamma^2)\sigma^2} \tag{12}$$

It can be seen from equations (11) and (12) that the online demand and offline demand of products are related to the trust transfer coefficient between channels, and the propositions obtained are as follows.

Proposition 2: "Online product consumption q_d^* demand increases with the trust transfer coefficient; offline product consumption demand q_r^* decreases with the trust transfer coefficient γ.

Prove: due to

$$q_d^* = \gamma^2 \frac{(1-\gamma^2)\theta + c_r - (2-\gamma^2)c_d}{2(1-\gamma^2)\sigma^2} = \gamma^2 \frac{\theta - c_d + \frac{c_r - c_d}{1-\gamma^2}}{2\sigma^2}$$

Where, $c_r - c_d > 0$. And since $\gamma \in (0,1)$, q_d^* increases with γ. The same, due to

$$q_r^* = \frac{(1-\gamma^2)\theta - (1-\gamma^2)c_d + c_d - t_r}{2(1-\gamma^2)\sigma^2} = \frac{\theta - c_d - \frac{c_r - c_d}{1-\gamma^2}}{2\sigma^2},$$

q_d^* increases with the increase of γ, and q_r^* decreases with the increase of γ. Proposition 2 is proven.

Increasing γ means that consumers' trust in online channels increases, and the perceived risk of shopping decreases. When the online channel trust of a product is successfully established, consumers' tendency to consume online will increase, increasing consumer demand for online products. Accordingly, the demand for offline products will decrease.

Furthermore, it can be obtained that under a given situation, the manufacturer's profit is

$$\pi_m^* = \frac{(1-\gamma^2)(\theta-c_r)^2+\gamma^2(1-\gamma^2)(\theta-c_d)^2+\gamma^2(c_d-c_r)^2}{4(1-\gamma^2)\sigma^2} - \frac{I}{1-\gamma^2} \tag{13}$$

The retailer's profit is

$$\pi_r^* = \frac{[(1-\gamma^2)\theta-c_r+\gamma^2 c_d]^2}{8(1-\gamma^2)\sigma^2} \tag{14}$$

Derivation of the manufacturer's profit versus the trust transfer coefficient γ in equation (13), we get

$$\frac{d\pi_m^*}{d\gamma} = \frac{2\gamma(\theta-c_d)^2}{4\sigma^2} + \frac{2\gamma(c_r-c_d)^2}{4(1-\gamma^2)^2\sigma^2} - 2I\gamma \tag{15}$$

In formula (15) $\frac{d\pi_m^*}{d\gamma} = 0$, under the equilibrium situation, when the manufacturer establishes an online channel for the product, the determined optimal trust transfer coefficient is

$$\gamma^* = \sqrt{1 - \sqrt{\frac{4\sigma^2 I-(c_r-c_d)^2}{(\theta-c_d)^2}}} \tag{16}$$

where γ^* is the trust transfer coefficient between channels, the manufacturer selects when expanding online channels.

4. Discussion of results

In the discussion of the results, the paper will discuss the value of γ^* under equilibrium decision-making to determine the relationship between the online and offline trust transfer coefficient and the degree of risk, investment cost coefficient, channel cost, and the profit of manufacturers and retailers in the supply chain.

When $[(\theta - c_d)^2 + (c_r - c_d)^2]/4\sigma^2 > 1 > (c_r - c_d)^2/4\sigma^2$, it can be ensured that γ^* is the interior point solution within the value range $\gamma \in (0,1)$. At this time, γ^* is the trust transfer coefficient between channels under equilibrium conditions; when γ^* has interior-point solutions, the following conclusions can be obtained from the expression of γ^*.

(1) $d\gamma^*/d\sigma < 0$, γ^* decreases with the increase of σ. This means that when manufacturers establish trust transmission from offline to online channels, their efforts and motivation will be affected by the quality of their products. If the manufacturer's product quality is high, there will be greater efforts and motivation to invest in the trust of online consumers; otherwise, the motivation to invest will decline. In fact, among the successful manufacturers that have established offline online, such as Samsung and Haier, the success of their offline-to-online channel expansion is due to the relatively stable quality of their products. The smaller the σ, the stronger the consumers' trust in the offline quality of the product. Therefore, the decrease of γ^* with the increase of σ also verifies that establishing trust in offline channels has a positive effect on trust in online channels—the main empirical results in the trust transmission literature.

(2) $d\gamma^*/dI < 0$, γ^* decreases with the increase of I. When establishing consumer trust in online websites, manufacturers can work hard to guide the transfer of consumer trust, build online channels, maintain original customer loyalty, and improve online consumer satisfaction in each transaction. When reaching the same trust establishment coefficient, the cost will be higher if the cost factor is larger. The high cost will affect the manufacturer's effort and motivation to establish online trust.

(3) $dy^*/d(c_r - c_d) > 0$, γ^* increases with the increase of $(c_r - c_d)$, indicating that the greater the physical channel cost, the more successful the online channel cost savings, the more motivated the manufacturer to establish a higher consumer trust transfer coefficient. This is because $c_r > c_d$. When $(c_r - c_d)$ is larger, online channels have more obvious cost advantages than offline channels. Manufacturers are more motivated to increase consumer trust in online channels and let consumers choose Online shopping.

When $I > [(\theta - c_d)^2 + (c_r - c_d)^2]/4\sigma^2$, it can be seen from equation (15) that $\frac{d\pi_m^*}{d\gamma} < 0$ is always satisfied in the interval of $\gamma \in (0,1)$, which means that the profit decreases with increasing. In this case, the cost of establishing trust in online channels is too high. The smaller the trust transfer coefficient determined by the manufacturer, the better, and the manufacturer will give up efforts to establish online consumer trust.

When $I < (c_r - c_d)^2/4\sigma^2$, it can be seen from formula (15) that $\frac{d\pi_m^*}{d\gamma} > 0$ is always satisfied in the $\gamma \in (0,1)$ interval, which means that the profit increases with the increase of γ. In this case, the cost of establishing trust in online channels is not high, and the greater the trust transfer coefficient determined by the manufacturer, the better so that consumers' confidence in online shopping and offline shopping will be as similar as possible to reduce consumers' perceived risks online.

Furthermore, in the numerical simulation, the correlation analysis of the trust transfer coefficient γ formed by expanding the product from offline channels to online channels by each parameter is performed, and the parameters are shown in Table 1.

Combining the changes of the parameters given in Table 1 with the trust transfer coefficient, Figure 1 depicts the changes of each parameter in the $\gamma \in (0,1)$ interval and expresses the relationship between each parameter and the trust transfer coefficient.

Table 1. Variation of parameters with trust transfer coefficients γ

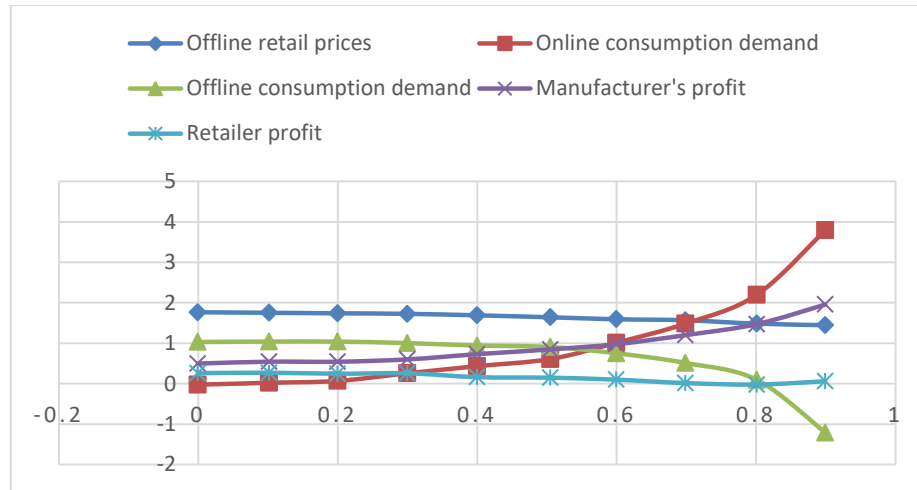| variable	r							
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
p_r^*	1	1.79	2.6	3.3	3.9	4.6	5.1	5.51
q_d^*	-1	-0.4	0.2	0.8	1.4	2.1	2.6	2.67
q_r^*	-0.01	1.08	1.6	1.8	1.8	1.7	1.6	1.2
π_m^*	0.01	0.51	1.6	2.9	4.5	6.4	8.5	11
π_r^*	0	0.2	0.5	0.8	1	1	0.7	0.38

Figure 1. Variation of parameters under different trust transfer coefficients γ

Combining Table 1 and Figure 1, it can be seen that as the trust transfer coefficient increases, consumers' risk perception decreases, and the offline retail price p_r^* gradually decreases to attract consumers, which verifies the conclusion of Proposition 1 in the article. At the same time, online product consumption demand q_d^* and trust transfer coefficient γ have a positive correlation change relationship, and offline product consumption demand q_r^* and γ have a negative correlation change relationship. When γ increases, consumers flow online to consume, which verifies Proposition 2 in the article. The manufacturer's profit π_m^* increases with the increase of the offline-to-online trust transfer coefficient γ, and the retailer's profit π_r^* decreases with the increase of the trust transfer coefficient γ, which verifies the result of Proposition 2 in the article.

5. Conclusion

Establishing product online trust has become a key element of the success of its online sales. This article constructs the consumer utility function under the influence of perceived risk and online trust level, discusses how the difference in consumer perception of risk between online and offline shopping methods will affect channel pricing, and how the establishment of trust affects channel product price pricing. It further analyzes the relationship between online and offline trust transfer coefficient and risk degree, investment cost coefficient, channel cost, and profit of manufacturers and retailers in the supply chain. The following conclusions of different channel models may have some changes. Still, this article can provide a theoretical model for the study of channel trust transmission and provide ideas for exploration. At the same time, the future research of this article can include comparing different channel modes under the influence of perceived risk and consumer trust, the profit changes of each member in the channel, and discussing how to choose the channel mode under the influence, perceived risk, and trust. In addition, to further understand the consumer experience or the shopping process, to discuss consumer behavior, channel members' price decisions, and channel model choices under the trade-off of shopping time, waiting time, perceived risk, and product price.

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