Research on contract coordination of supply chain under dual behavior preference based on Stackelberg model

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Abstract: Based on the Stackelberg model between suppliers and retailers, fairness concern and loss avoidance are introduced into suppliers and retailers in supply chain. This paper discusses whether the balance of supply chain can be realized through the repurchase contract and repurchase-revenue sharing contract when they have dual psychological preferences. Establishing utility functions based on two different contracts, combined with the expression of utility functions, discuss the feasibility and necessary conditions of pursuing utility maximization and realizing supply chain coordination when supply chain members have dual preferences. Through the derivation of mathematical model and the analysis of numerical examples, it is concluded that suppliers and retailers with dual behavior preference can achieve supply chain coordination through repurchase contract when they have a certain degree of fairness concern and loss avoidance, but can not achieve supply chain coordination through repurchase-revenue sharing contract. In this process, the utility of the two sides will also change with the degree of their fair concerns and loss avoidance. Whether the two parties can realize their interest is the key to the final cooperation.

Keywords: Stackelberg model, Repurchase contract, Repurchase-revenue sharing contract, Fair concern and loss avoidance, Supply chain coordination

1. INTRODUCTION

In the context of supply chain, due to the existence of multiple members, there will be two psychological preferences[10, 14], fairness concern and loss aversion[5, 42]. When distributing benefits according to contracts among supply chain members, psychological preferences have an important impact on designing supply chain coordination mechanism [6, 51]. A "passionate collision" happened between Gome and Gree in 2004. According to Gree, Gome demanded a high sales rebate from Gree and a 40 percent fees as fees as Gome's profit, which Gree believed these acquisitions seriously of the air conditioning installation affected the fairness of its own profit.

Gome thinked that Gree's multilevel distribution model has led to excessive costs and air conditioning prices. This will affect sales volume of air conditioners, resulting in the revenue decline. It destroys the fairness of profit distribution and produces certain loss. This mode

EMIS 2023, February 24-26, Chengdu, People's Republic of China

DOI 10.4108/eai.24-2-2023.2330643

deviates from the hypermarket mode of "small profits and quick sales" required by Gome. In the end, the two companies ended their cooperation. This indicates that when making decisions, supply chain members will not only pay attention to the fairness of income distribution[3], but also tend to avoid losses, because people who are more concerned about fairness tend to pay more attention to gains and losses. As a universal social preference, decision-makers not only pay attention to their own income fairness, but also consider the income fairness of others when making decisions [7]. In reality, it is also found that loss aversion is always accompanied by fairness preference[16, 35]. The effect of a certain amount of loss on psychological feelings is about twice that of income, which makes supply chain members afraid of loss of interests and no longer make decisions based on the maximum interests of the supply chain [9]. This will bring great harm to supply chain coordination.

2. LITERATURE REVIEW

Scholars have done a lot of research on supply chain contract coordination[21]. In 1960, Clark and Scarf firstly studied the coordination of supply chain. After 60 years of research, a number of mature theoretical systems have been formed. Supply chain contract has become an important method to realize the coordination of supply chain[24, 50]. Coordination of the supply chain can obtain through the repurchase contract[31, 56], and the profit of decentralized decision-making was far lower than the profit of supply chain coordination [11, 30, 37, 44]. Repurchase contracts is introduced into emergencies to achieve supply chain coordination by solving the problem under asymmetric information [48]. And repurchase contract is introduced into the emergency response and the researcher find that it can not only realize the profit of balance of the supply chain members, but also realize the coordination of the supply chain [49].

Psychological preference is an important content of behavioral supply chain[4], which has been explored by many scholars at home and abroad. The optimal order quantity of risk-neutral retailers is greater than that of risk-averse retailers[2, 8, 55, 60]. In manufacturing-oriented supply chain management, the weak members' tend to pay attention to fairness which make them seize the profits from other member to increase their income distribution[45]. Huang(2015) and Xue(2018) researched the retailer-led supply chain management with fairness preference by establishing models and numerical analysis, she concluded that the profit and performance of the supply chain system changed with fairness concerns of suppliers and retailers[54, 57, 59]. The coordination problem of supply chain with suppliers having preference, which concluded that suppliers with dual preferences can effectively regulate supply chain coordination [48, 58]. Decision and coordination of the supplier oriented supply chain under dual behavioral preferences. The researchers found that the decision limitation for suppliers to realize supply chain coordination under random linear demand was narrow, while the conditions to be met under nonlinear random demand were simpler, and providing suppliers with larger decision space [1, 29]. Gu(2016) put forward the conclusion that supply chain coordination can still be achieved by revenue sharing contracts under the assumption of loss aversion[19, 23, 41]. Cui et al. (2017)explored the impact of retailers' equity preferences on supply chain equilibrium strategies in manufacturer-led supply chains with wholesale contracts. Some researchers studied the impact of loss aversion behavior on decision-making results when retailers pay attention to flexible ordering and cost control [27].

The above-mentioned literature has explored a lot of supply chain contract coordination with psychological preference, laying a foundation for subsequent research. However, these literature has the following shortcomings: (1) The existing literature discuss the supply chain coordination problem when only one supply chain member has one single preference. However, the complexity of human behavior means that each member of the supply chain can have the dual preference of fairness concern and loss avoidance. (2) Most of the literature studies the models of revenue sharing contract[17, 38, 40], wholesale price contract[25, 43] and repurchase contract[52], but few studies research on joint contract. With the extensive application of joint contract[61], this paper discusses the combination of repurchase contract and revenue sharing contract. Compared with the traditional supply chain researching model and the single contract model based on the "rational person" hypothesis, this paper is more practical and has greater research value and guiding significance. This paper comprehensively considers the supply chain contract coordination problem when the supplier and the retailer have two psychological preferences of fairness concern and loss avoidance. Assuming a secondary supply chain market, under the mode of repurchase contract and repurchase-income sharing contract, two psychological preferences of fairness concern and loss avoidance are introduced to establish a supply chain model. Based on these two models, the numerical examples are verified. The results show that the proposed model can provide decision support for coordination of supply chain contract when supply chain members have dual preferences.

3. PROBLEM DESCRIPTION AND MODEL ASSUMPTION

Based on a supply chain system including a single supplier and a single retailer, this paper studies the influence of dual behavior preference on supply chain members' decision-making and the conditions of supply chain coordination under repurchase contract and repurchase-revenue sharing contract, where the supplier and the retailer have dual behavior preference of fairness and loss avoidance. When the two parties making Stackelberg game, the supplier acts as leader to make decisions firstly[33]. In the decision-making process, the supplier proposes the wholesale price on the premise that the income of the two parties are fair and does not make them lose interests. As a follower, retailers make decisions according to the price proposed by suppliers. Similarly, when making decisions, retailers should consider whether the price proposed by suppliers is fair and whether it will affect their own interests, so as to determine the order quantity.

Assume that the random demand in the consumer market is$D(D > 0)$[32, 34], the probability density function of its distribution is $f(x) > 0$, and the probability distribution function is F(x), F(x) is continuous and monotonically increasing. $F(0) = 0$. The unit wholesale price of the product sold by the supplier to the retailer is ω, the unit cost is c, and the order quantity of the retailer buying from supplier is Q, and the unit price P is sold to downstream consumers by retailers. Assume product back order costs, retailer marginal costs and the net salvage value of unsold products are 0.

According to Stackelberg theory, the product sales process is as follows: the supplier, as the leader of the supply chain, proposes a wholesale price ω firstly, and the retailer makes a decision according to the price proposed by the supplier and specifies the corresponding order quantity Q. After the order is completed, it is sold to downstream consumers at the price

$P(P > \omega)$. S(Q) and I(Q) respectively represent the expected sales volume and the expected remaining inventory of the product. According to the Newsvendor Model, [13, 24, 39, 46]:

$$S(Q) = Q - \int_0^Q F(x)d(x)$$

$$I(Q) = \int_0^Q F(x)d(x)$$

When all members of the supply chain are rational decision makers, the expected return (expressed in II_s) of the supplier is:

$$II_s(Q) = (\omega - c)Q$$

The expected revenue of the retailer is:

$$II_r(Q) = (P - \omega)Q - P\int_0^Q F(x)d(x)$$

The overall expected return of the supply chain is:

$$II(Q) = II_s(Q) + II(Q) = (P - c)Q - P\int_0^Q F(x)d(x)$$

In this case, the optimal order quantity of the system when the supply chain reaches the maximum revenue is Q, which meets the following requirements:

$$Q = F^{-1}\left(\frac{P - c}{P}\right)$$

The repurchase contract[44] is described as: at the end of the sales period, the supplier buys back the unsold products of the retailer at the unit price b(0<b< ω). The revenue sharing contract(Lan, 2019) can be described as: the retailer retains part of the $\emptyset$ of the revenue and shares $1 - \emptyset$ $(0 < \emptyset < 1)$ of the revenue with the supplier as compensation. Repurchase-revenue sharing contract can be described as: considering both the repurchase contract and the revenue sharing contract. The retailer transfers part of the revenue to the supplier, and the supplier must buy back the products that the retailer has not sold at the end of the term. Based on the repurchase contract and the repurchase-revenue sharing contract, this paper discusses the coordination of supply chain under the dual preference of fair concern and loss avoidance between suppliers and retailers.

4. MODEL CONSTRUCTION ANS ANALYSIS

4.1 Utility function model under behavioral preferences

When the members of the supply chain have some behavior preference, their aims of decision-making process will not only at maximizing their own benefits, but also at maximizing their own utility from their behavior preference intention[36].

When the supplier has a loss aversion preference, the utility expression is:

$$U_s = \begin{cases} II_s & II_s \geq 0 \\ \lambda_1 II_s & II_s \leq 0 \end{cases}$$

Similarly, when the retailer has a loss aversion preference, the expression is:

$$U_r = \begin{cases} II_r & II_r \geq 0 \\ \lambda_2 II_r & II_r \leq 0 \end{cases}$$

The λ_1、λ_2（$\lambda_1 > 0$、$\lambda_2 > 0$）respectively represent the degree of loss aversion of suppliers and retailers , reflecting the degree of loss aversion of decision-makers. $\lambda=1$ indicates that decision-makers are risk neutral, $\lambda > 1$indicates that decision-makers are loss averse. The larger λ is, the higher the degree of loss aversion of decision-makers is. Suppliers and retailers with loss-averse behavior preference take this function as the standard, and pursue their own utility maximization when trading with each other.

When the supplier has a fair concern behavior preference, its decision-making process refers to the following effective expression:

$$U_s = (1+\alpha_1)II_s - \alpha_1 II_r$$

Similarly, when the retailer has a fair concern preference, the expression is:

$$U_r = (1 + \alpha_2)II_r - \alpha_2 II_s$$

The α_1、α_2（$\alpha_1 > 0$、$\alpha_2 > 0$）represent the fairness concern degree of suppliers and retailers respectively, which reflects the concern degree of decision-makers for the fairness of relative earnings. The larger α is, the higher sensitivity of decision-makers to fairness is. The suppliers and retailers with fair preferences are subject to this function, and they seek to maximize their own utility when trading with each other.

When the supplier and the retailer have both fairness concern and loss aversion, the utility expression of the supplier under double preference can be obtained by synthesizing the above two utility function expressions:

$U_s = (1 + \alpha_1)II_s - \alpha_1 II_r + (\lambda_1 - 1)G_s$($G_s$ represents the loss of supplier) （1）

When the retailer has both fair concern and loss avoidance behavior preference, the expression is:

$U_r = (1 + \alpha_2)II_r - \alpha_2 II_s + (\lambda_2 - 1)G_r$($G_r$Represents the loss of retailer） （2）

4.2 Repurchase contracts under dual behavioral preferences

Under the repurchase contract, the supplier wholesales the goods to the retailer at the unit price ω. At the end of the sales period, the supplier repurchase the unsold products at the unit price b（$b < \omega$). Under the repurchase contract, the income expression of supplier and retailer are:

$$II_s^b(Q_b) = (\omega - c)Q_b - b\int_0^Q F(x)d(x)$$

$$II_r^b(Q_b) = (P - \omega)Q_b - (P - b)\int_0^Q F(x)d(x)$$

The loss of supplier is:

$$G_s^b = -b\int_0^{\frac{(\omega-b)Q_b}{p-b}} F(x)d(x)$$

The loss of retailer is:

$$G_r^b = -（p-b)\int_0^{\frac{(\omega-b)Q_b}{p-b}} F(x)d(x)$$

The overall income of the supply chain is consistent with the centralized supply chain, which is still:

$$II^b(Q_b) = (P-c)Q_b - P\int_0^{Q_b} F(x)d(x)$$

At this time, the optimal order quantity Q_b of the supply chain still meets:

$$Q_b = Q = F^{-1}\left(\frac{p-c}{p}\right)$$

According to Equation (1), the supplier's utility is:

$$\begin{aligned} U_s^b(\omega) = (1+\alpha_1)\left[(\omega-c)Q_b - b\int_0^{Q} F(x)d(x)\right] \\ -\alpha_1\left[(P-\omega)Q_b -（P-b）\int_0^{Q_b} F(x)d(x)\right] \\ -(\lambda_1-1)b\int_0^{\frac{(\omega-b)Q_b}{p-b}} F(x)d(x) \end{aligned}$$

Under the repurchase contract, the supplier with dual behavioral preference should maximize its own utility, so

$$\begin{aligned} \frac{\partial U_s^b(\omega)}{\partial\omega} = \left[(1+2\alpha_1)-(\lambda_1-1)\frac{b}{p-b}F(\frac{\omega-b}{p-b}Q_b(\omega))\right]Q_b(\omega) + \left[(1+2\alpha_1)\omega-(1+\alpha_1)c-\right. \\ \left.\alpha_1 p+\alpha_1(p-2b)F(Q_b(\omega))-(\lambda_1-1)\frac{(\omega-b)b}{p-b}F(\frac{\omega-b}{p-b}Q_b(\omega))\right]\frac{\partial U_s^b(\omega)}{\partial\omega} = 0 \end{aligned} \quad (3)$$

$$\frac{\partial^2 U_s^b(\omega)}{\partial\omega^2} < 0, \text{so}\ \lambda_1 > 1 + \frac{[\alpha_1(p-2b)-b]F(Q_b(\omega))}{\frac{b(\omega-b)}{(p-b)^2[Q_b(\omega)+(\omega-b)]F(\frac{\omega-b}{p-b}Q_b(\omega))}} \quad (4)$$

Under the repurchase contract, the utility of the retailer under the dual behavioral preference is:

$$U_r^b(Q_b) = (1+\alpha_2)\left\{P\left[Q_b - \int_0^{Q_b} F(x)d(x)\right] - \omega Q_b + b\int_0^{Q_b} F(x)d(x)\right\} - \alpha_2\left[\omega Q_b - cQ_b - b\int_0^{Q_b} F(x)d(x)\right] - (\lambda_2 - 1)\left[(P-b)\int_0^{\frac{\omega-b}{p-b}Q_b} F(x)d(x)\right]$$

Under the dual behavior preference, retailers should maximize their own utility, so that:

$$\frac{\partial U_r^b(Q_b)}{\partial Q} = (1+\alpha_2)\{P[1-F(Q_b)] - \omega - bF(Q_b)\} - \alpha_2[\omega - c - bF(Q_b)] - (\lambda_2 - 1)(P - b)\left(\frac{\omega-b}{p-b}\right)F\left(\frac{\omega-b}{p-b}Q_b\right) = 0 \quad (5)$$

$$\frac{\partial^2 U_r^b(Q_b)}{\partial {Q_b}^2} < 0,\ \text{so}\ \lambda_2 > 1 + \frac{(p-b)[\alpha_2 b - (1+\alpha_2)p + (1+\alpha_2)bF(Q_b)]}{(\omega-b)^2 F\left(\frac{\omega-b}{p-b}Q_b\right)} \quad (6)$$

In order to realize supply chain coordination, it is necessary to maximize the utility of suppliers and retailers, and at the same time, the retailer's order quantity is equal to the optimal order quantity of the system. Then:

$Q_b = Q = F^{-1}\left(\frac{P-c}{P}\right)$, and $F(Q_b) = \frac{P-c}{P}$, put into（5）：

$$F\left(\frac{\omega-b}{p-b}Q_b\right) = \frac{(b+c-\frac{bc}{p}-\omega)(2\alpha_2+1)}{(\lambda_2-1)(\omega-b)} \quad (7)$$

Whenα_1、α_2、λ_1、$\lambda_2$is constant, ω and b satisfy formula (4) (6) (7), the goods are sold to retailers at wholesale price ω, and repurchased at unit price b. At this time, the retailer's optimal order quantity is the same as the system's optimal order quantity, which can promote the coordination of the supply chain.

4.3 Joint contract of repurchase and income sharing under dual preference

Under the repurchase-revenue sharing contract, the supplier sells goods to the retailer at a unit price ω, and at the end of the sale, the suppliers repurchase the unsold products from the retailers at a unit price b (b< ω). At the same time, retailers need to share the profits with suppliers in a certain proportion. Assume that the retailer keeps $\emptyset$ of the sales revenue and gives $(1-\emptyset)$ (0< $\emptyset$ <1) to supplier. Under the joint contract, the revenue of the supplier is:

$$II_s^c(Q_c) = (\omega - c)Q_c + (1-\emptyset)P\left[Q_c - \int_0^{Q_c} F(x)d(x)\right] - b\int_0^{Q_c} F(x)d(x)$$

The revenue of the retailer is:

$$II_r^c(Q_c) = \emptyset P\left[Q_c - \int_0^{Q_c} F(x)d(x)\right] - \omega Q_c + b\int_0^{Q_c} F(x)d(x)$$

The loss of the supplier is:

$$G_s^b = -(b - \emptyset P)\int_0^{\frac{(\omega-b)Q_c}{(\emptyset p-b)}} F(x)d(x)$$

The loss for the retailer is:

$$G_r^b = -（\emptyset p - b)\int_0^{\frac{(\omega-b)Q_c}{(\emptyset p-b)}} F(x)d(x)$$

The revenue expression of supply chain system is:

$$II^c(Q_c) = (P - c)Q_c - P\int_0^{Q_c} F(x)d(x)$$

The optimal order quantity of supply chain system is:

$$Q_c = Q = F^{-1}\left(\frac{P - c}{P}\right)$$

The utility function of the supplier is:

$$\begin{aligned} U_s^c(\omega) = \alpha_1 &\left\{(\omega - c)Q_c + (1 - \emptyset)P\left[Q_c - \int_0^{Q_c} F(x)d(x)\right] - b\int_0^{Q_c} F(x)d(x)\right\} \\ &- \alpha_1\left[(\emptyset P - \omega)Q_c - (\emptyset P - b)\int_0^{Q_c} F(x)d(x)\right] - (\lambda_1 - 1)(P - \emptyset P \\ &+ b)\int_0^{\frac{(\omega-b)Q_c}{(\emptyset p-b)}} F(x)d(x) \end{aligned}$$

Under the joint contract, the supplier should maximize its own utility by:

$$\begin{aligned} \frac{\partial U_s^c(\omega)}{\partial \omega} = 0, \frac{\partial U_s^c(\omega)}{\partial \omega} &= \alpha_1\{(\omega - c) + (1 - \emptyset)P[1 - F(Q_c)] - bF(Q_c)\} \\ &- \alpha_1[(\emptyset P - \omega) - (\emptyset P - b)F(Q_c)] - (\lambda_1 - 1)(P - \emptyset P \\ &+ b)\frac{(\omega - b)Q_c}{(\emptyset p - b)}Q_c F(\frac{\omega - b}{(\emptyset p - b)}Q_c) \end{aligned}$$

$$\frac{\partial^2 U_s^c(\omega)}{\partial \omega^2} < 0, so \lambda_1 > 1 + \frac{(2\alpha_1 p\emptyset - 2\alpha_1 b + \alpha_1 p)F(Q_c)}{(P - \emptyset P - b)(\frac{\omega - b}{\emptyset p - b})^2 F(\frac{\omega - b}{\emptyset p - b}Q_c)} \qquad (8)$$

The utility function of the retailer is:

$$\begin{aligned} U_r^c(Q_c) = (1 + \alpha_2) &\left\{\emptyset P\left[Q_c - \int_0^{Q_c} F(x)d(x)\right] - \omega Q_c + b\int_0^{Q_c} F(x)d(x)\right\} \\ &- \alpha_2\left\{\omega Q_c - cQ_c + (1 - \emptyset)P\left[Q - \int_0^{Q_c} F(x)d(x)\right] - b\int_0^{Q_c} F(x)d(x)\right\} - (\lambda_2 \\ &- 1)\left[(\emptyset P - b)\int_0^{\frac{(\omega-b)Q_c}{(\emptyset p-b)}} F(x)d(x)\right] \end{aligned}$$

Under the joint contract, to maximize the utility of the retailer with dual behavioral preference, let:

$$\frac{\partial U_r^c(Q_c)}{\partial Q_c}=0,\ \text{so}\ \frac{\partial U_r^c(Q_c)}{\partial Q_c}=(1+\alpha_2)\{\emptyset P[1-F(Q_c)]-\omega+bF(Q_c)\}-\alpha_2[\omega-c+(1-\emptyset)P[1-F(Q_c)]-bF(Q_c)]-(\lambda_2-1)\left[(\emptyset P-b)\frac{\omega-b}{(\emptyset p-b)}Q_cF(\frac{\omega-b}{(\emptyset p-b)}Q_c)\right]=0$$

$$\frac{\partial^2 U_r^c(Q_c)}{\partial {Q_c}^2}<0,\text{so}\ \lambda_2>1+\frac{(\emptyset P-b)(\alpha_2 P-\emptyset P-2\alpha_2\emptyset P+b+2\alpha_2 b)F(Q_c)}{(\omega-b)^2F(\frac{\omega-b}{(\emptyset p-b)}Q_c)} \quad (9)$$

When $Q_c=Q=F^{-1}\left(\frac{P-c}{P}\right)$, the supply chain can achieve coordination.

Substituting $F(Q_c)$ into equation (9), we can obtain:

$$F(\frac{\omega-b}{(\emptyset p-b)}Q_c)=\frac{(b+c-\frac{bc}{p}-\omega)(2\alpha_2+1)}{(\lambda_2-1)(\omega-b)} \quad (10)$$

Whenα_1、α_2、λ_1、$\lambda_2$is constant, and ω and b satisfy equation (8) (9) (10), the supplier sells goods to the retailer at the wholesale price ω, and the retailer gives part of its own income$1-\emptyset$ to the supplier at the end of the sales period. At this time, the retailer's optimal order quantity is the same as the system's optimal order quantity, which can promote the coordination of the supply chain.

5. DISSCUSION AND RESULTS

This paper analyzes the coordination of supply chain under the repurchase contract and repurchase-revenue sharing contract when the supplier and retailer have dual preferences. In order to verify the validity of the contract model, the above results are verified by a numerical example.

Assuming that the random demand of the consumer market follows a normal distribution, and the distribution function is D~N（500，100^2）, assume P=160，c=100, b=50, ω=130, $\emptyset$=0.65, calculating that $Q_b=Q_c=468.5$. According to different values of α_1、α_2、λ_1、λ_2, we can obtain the different value of U_s^b，U_r^b. As shown in Table 1 and 2:

Table 1 Impact of dual behavior preference under repurchase contract on supply chain coordination

λ_1	λ_2	α_1	α_2	Q_b	U_s^b	U_r^b
1.2	1.2	0.1	0.1	468.5	13179.3908	12637.1550
1.5	1.5	1.0	1.0	468.5	12508.7570	15738.2174
1.5	1.1	1.5	0.5	468.5	12223.0770	14283.0395
1.5	2.0	2.0	3.0	468.5	11937.3971	22820.6348
1.5	1.5	0.1	0.1	468.5	13022.9813	12293.0534
2.0	1.5	1.0	0.5	468.5	12248.0742	13824.2374
3.0	2.0	1.0	0.5	468.5	11726.7080	13250.7348

According to Table 1, when the fairness relevance is unchanged, the supplier's utility decreases with the increase of loss aversion. When the degree of loss aversion is constant, the utility of the supplier decreases with the increase of the fairness relevance. Therefore, suppliers can obtain higher utility if they keep low fair relevance and low loss aversion. When the fairness relevance is constant, the retailer's utility decreases with the increase of loss aversion. When the loss aversion is constant, the retailer's utility increases with the fairness relevance. Therefore, the retailer can obtain higher utility by maintaining a higher degree of fair relevance and a lower degree of loss aversion. When the fairness relevance and loss aversion are the same, the smaller the fairness relevance and loss aversion are, the smaller the utility difference between them will be. The more balanced mind of the supplier and retailer, the more likely the cooperation will be.

Table 2 Impact of dual behavior preference under the joint contract of repurchase income sharing on supply chain coordination

λ_1	λ_2	α_1	α_2	Q_b	U_s^b	U_r^b
1.2	1.2	0.1	0.1	478.5	4724.7388	-18353.5747
1.5	1.5	1.0	1.0	478.5	50608.6990	-65252.3566
1.5	1.1	1.5	0.5	478.5	76473.2671	-38931.1097
1.5	2.0	2.0	3.0	478.5	102337.8350	-169281.6093
1.5	1.5	0.1	0.1	478.5	4052.4766	-18696.0479
2.0	1.5	1.0	0.5	478.5	49488.2621	-39387.7406
3.0	2.0	1.0	0.5	478.5	47247.3880	-39958.5393

It can be seen from table 2 that when the fairness concern is unchanged, the utility of the supplier decreases with the increase of the loss avoidance degree; When the loss avoidance degree is constant, the utility of suppliers increases with the increase of fairness concern. Therefore, if suppliers maintain a high degree of fairness concern and a low degree of loss avoidance, they can get high utility value; When the fairness concern is constant, the retailer's utility decreases with the increase of loss avoidance; When the loss avoidance degree is constant, the retailer's utility decreases with the increase of fairness concern. Therefore, retailers can obtain high utility value by maintaining a low level of fairness concern and a low level of loss avoidance. The utility of retailers in the table is negative, so under this environmental parameter, the repurchase-revenue sharing contract cannot make suppliers and retailers reach cooperation.

6. CONCLUSION

Based on the Newsvendor Model of supply chain, this paper introduces two kinds of behavioral preferences fairness concern and loss aversion into suppliers and retailers in the supply chain. Through the two contract models of repurchase contract and repurchase-revenue sharing contract, the paper analyzes whether the two sides can reach cooperation when they have two psychological preferences, and the influence of these two behavioral preferences on their decision-making. The specific conclusions are as follows:

(1) Under certain environmental parameters, the repurchase contract could reach cooperation. When suppliers and retailers have the same degree of fairness concern and loss avoidance, they are more likely to achieve cooperation. In this case, the difference of utility between supplier and retailer is the smallest and the cooperation is the least likely to break. Therefore, when both parties cooperating, they should try to choose the repurchase contract, and both parties should meet the above formula (4) (6) (7) when formulating the wholesale price and unit price, so as to promote the coordination of the supply chain. Moreover, both parties should not only pay attention to their own psychological comfort, but also consider the feelings of the other party when cooperating.

(2) Under the same environmental parameters as the repurchase contract, the repurchase-revenue sharing contract cannot reach cooperation. In this case, the retailer's utility is negative. Repurchase-revenue sharing contract refers to the coordination method combining repurchase contract (supplier repurchases retailer's unsold products at a price lower than wholesale price) and revenue sharing contract (retailer delivers a certain proportion of sales revenue to supplier to obtain lower wholesale price and improve supply chain operational performance). In order to ensure the cooperation between suppliers and retailers, try not to choose repurchase-revenue sharing contract.

(3) When suppliers and retailers cooperating, they should take friendly cooperation as the premise to achieve win-win results. If a member of the supply chain pursues his own interests blindly in cooperation, which will make other party feels unfair, the cooperative relationship between the two parties will be broken. And both parties should communicate and understand the fair concern of the partner and the acceptance of losses when they signing the contract.

This paper only considers the two-member and second-level supply chain, it does not extend the multi-level supply chain environment, which will increase the difficulty of model establishment and the complexity of calculation example analysis. The above deficiencies will be further explored and improved in the subsequent research.

Authors'Contributions: The main contribution of Lianjun Cheng is to revise the paper and support the methodology. The main contribution of Tong Zhang is article writing, data collection and support the methodology.

Acknowledgments:
First of all, I would like to express my gratitude to all those who helped me during the writing of this thesis. I gratefully acknowledge the help of my supervisor, Dr Cheng, who has offered me valuable suggestions in the academic studies. In the preparation of this thesis, he has spent much time reading through each draft and provided me with inspiring advice. Without his patient instruction, insightful criticism and expert guidance, the completion of this thesis would not have been possible.

Second, I also gratitude to my friends. When I encountered difficulties in writing, they gave me encouragement and help. I can finish my thesis successfully.

Last, I should finally like to express my gratitude to my beloved parents who have always been helping me out of difficulties and supporting without a word of complaint.

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