Construction and Application of the Coordination Model of Supply Chain Revenue Sharing Mechanism Dominated by the Military Enterprises

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Abstract: There are conflicts between individual rationality and collective rationality in the supply chain operation of military enterprises. In order to reduce the adverse impact on supply chain, it is necessary to actively construct the supply chain revenue sharing mechanism dominated by military enterprises based on game theory and system optimization method. The most basic is to establish the coordination model corresponding to the coordination mechanism, so as to realize the decision-making conflict between military enterprises and multiple warehouses, eliminate the double marginal effect, and improve the operational performance of military supply chain. This work mainly discussed the construction and application problems of the coordination model of supply chain revenue sharing mechanism dominated by military enterprises, and clarified its construction ideas, construction strategies and application scenarios, so as to maximize its coordination value.

1. Introduction

Information asymmetry will lead to inefficient operation of the supply chain, and the subject relationship cannot be effectively coordinated. For the supply chain operation of military enterprises, it is necessary to solve the problem of information asymmetry and establish a revenue sharing mechanism coordination model, so as to reverse the unfavorable position of military enterprises in the supply chain, so that they can realize the cooperation and coordination of military supply chain in the face of the information asymmetry of marginal cost of warehouse ordering [1]. In view of the general trend of improving the degree of information openness, it is realistic and feasible to establish the coordination model of supply chain revenue sharing mechanism dominated by military enterprises and play its coordination role.

2. Research on Military Supply Chain Operation Under the Background of Information Asymmetry

Information asymmetry is prevalent in the military supply chain. For example, the warehouse understands and grasps more information about the needs of troops, or for security reasons, it is impossible to let military enterprises fully know the system of the warehouse, storage plan, warehouse distribution, guarantee force, and order cost. Information asymmetry is easy to lead to reverse selection, decision distortion and supply chain coordination destruction. On this basis, a coordination model of supply chain revenue sharing mechanism dominated by military enterprises should be established to make up for the disadvantage of military enterprises and seek military supply chain cooperation and coordination under warehouse ordering of marginal cost information asymmetry. Some scholars have discussed the coordination of optimal revenue sharing contract in supply chain under random demand and asymmetric ordering cost information of single retailer. A mathematical model is established, in which the supplier determines the proportion of revenue sharing and wholesale price, and the retailer decides the quantity of order. Finally, it is concluded that it is necessary for suppliers to identify the unobtainable private cost information of retailers, so as to design an optimal

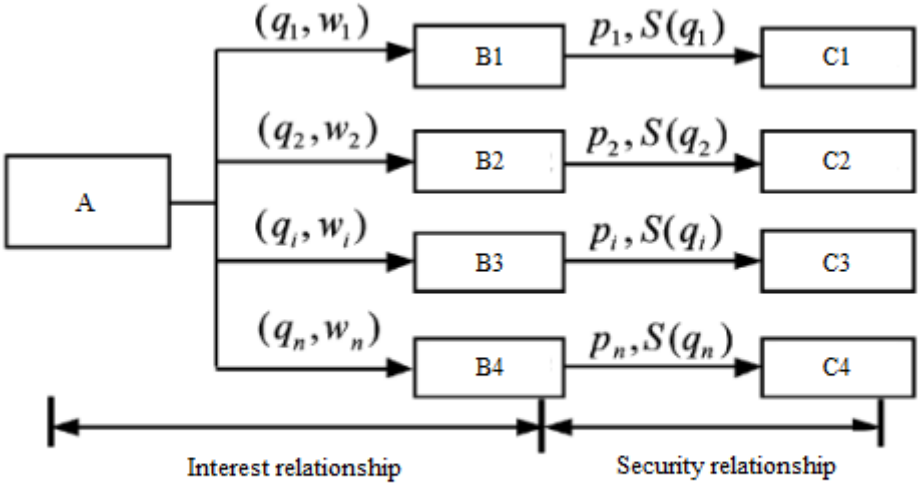
revenue sharing strategy to motivate retailers, which will lead to the decrease of revenue and the increase of revenue of retailers. Some scholars also take a two-level supply chain as the research object to analyze the supply chain coordination problem when both manufacturer and seller costs are private information. Under the condition of bilateral cost information asymmetry, the mechanism of "altruistic client" and "AGV" is introduced to reveal the real cost information, and a set of improved transfer payment mechanism is designed based on the expectation information rent distribution rules of both parties, which can not only reveal the real cost information but also achieve supply chain coordination [2].

3. Coordination Model of Supply Chain Revenue Sharing Mechanism Dominated by the Military Enterprises

A military supply chain model is constructed, which consists of a military enterprise (product manufacturer), multiple warehouses (service provider) and multiple military users. As shown in Fig. 1. The general design process of the revenue sharing mechanism is as follows: the military enterprise proposes the mechanism to the warehouse, and the warehouse decides to accept or reject it according to the random demand of military users, if accepted, the two sides shall sign a revenue sharing mechanism, the warehouse orders a certain number of products from the military enterprise, the military enterprise purchases raw materials according to the order quantity of the warehouse, organize production and supply products to the warehouse, and the warehouse pays for goods according to the wholesale price stipulated by the mechanism and the proportion stipulated by the mechanism and the military enterprises share the income and revenue. If the random demand of military users and the cost of military supply chain change, both sides need to re-evaluate the change of military supply chain and consider whether to continue cooperation [3].

3.1 Model assumption

Considering the military supply chain of short life-cycle logistics materials (such as supplies, military needs, etc.) of a single product, the demand of military users is random. The military enterprise is in a dominant position in the supply chain, and the revenue sharing mechanism is designed. If the warehouse accepts, the cooperation begins. Military enterprises refer to the enterprises that produce military goods, which must meet the order quantity of all warehouses and are not allowed to be out of stock. The information between military enterprises and warehouses is symmetrical, the cost composition and benefit function of each other are transparent, and both can make accurate prediction of the random demand of military users. Military enterprises and warehouses are risk neutral and rational decision makers, the decision criteria is the expected maximum return.



A: Military enterprise S; B1:Warehouse 1;B2: Warehouse 2; B3: Warehouse i; B4: Warehouse n; C1: Military user 1; C2: Military user 2; C3: Military user i; C4: Military user n.

Fig 1. The Military supply chain model

3.2 Symbol description

pi is the price of the product supplied by the ith warehouse. Considering military users, it can be set to a definite value, where i=1, 2... n. qi is the quantity of products ordered by the ith warehouse, and the quantity ordered by the warehouse in the whole supply chain is vector q= (q1, q2..., qi,...qn), and q=ni=1Σqi. The wholesale price of products provided by wi to warehouse i by military enterprises can be different depending on the location. c is the unit production cost of military enterprises (such as procurement of raw materials, design and production costs, freight, etc.); ci is the unit order cost of the ith warehouse (such as handling fee, storage fee, handling fee, distribution fee, etc.). vi is the unit residual value of the remaining products in warehouse i, that is, the unit residual value of the products that have not been sent out, which is generally realized through low-price treatment or recycling. Here, the way of recycling is adopted by military enterprises, and bi is the unit recovery price of the remaining products. Recycling can encourage the warehouse to order more products and fully meet the needs of users, but the recycling price should be greater than the residual value of the remaining products, and should be less than the wholesale price of military enterprises that is, 0<vi<bi<wi, wi+ci≤ pi. At the same time, the warehouse cannot profit from the products that have not been sent out, so there is bi+vi≤wi. xi is the random demand of the user served by the ith warehouse, xi>0, and its distribution function is F(xi), density function is f(xi), F(xi) is continuously differentiable and strictly increasing, and F(0)=0, F(xi)=1-F (xi), μi =E(xi)=∞0*e$^{xif(xi)dxi}$. It is the expectation of random quantity. $F^{-1}(\cdot)$ is the inverse function of the random distribution function. L(qi) is the expected stock shortage of the warehouse at the end of a certain period, according to mathematical statistics, there is $L(q_i)=E[(x_i-q_i)^+]=\int_{q_i}^{+\infty}(x_i-q_i)f(x_i)dx_i=\mu_i-S(q_i)$, (φ, η, wi, bi, qi) is the revenue sharing mechanism provided by military enterprises to warehouses, where η is the proportion of the revenue of warehouse i to the total revenue of channel i of military supply chain system, and φ is the proportion of the revenue of warehouse i to the total revenue of channel i. At the same time, it is assumed that the proportion of the total revenue and income of the warehouse to the total revenue and income of the entire military supply chain is φ and η, and that of the military enterprise is 1-φ and 1-η. For channel i of military supply chain system, the benefits of warehouse and military enterprise from channel I are π(qi), πr (qi) and πs (qi), respectively, and π (qi) =πr (qi) +πs (qi). The total revenue of the whole supply chain system should be the sum of the revenue of all channels, that is, π (q) = ni = 1Σπ(qi).

4. Analysis of Military Supply Chain Performance with Revenue Sharing Mechanism

For channel I, the revenue sharing mechanism is conducted under the leadership of military enterprises, as shown in Fig. 2. The military enterprise sets the wholesale price Wi<c, and then provides the product to the warehouse. The warehouse promises to return its income and revenue to the military enterprise in accordance with the proportion φ and η stipulated by the mechanism, so as to make up for the loss caused by the price reduction of the military enterprise, and finally ensure that the income of both sides is not lower than the income without the revenue sharing mechanism. The game process is as follows: the military enterprise determines φ, η, wi and bi, and the warehouse i decides its own qi. After that, the military enterprise adjusts φ, η, wi and bi appropriately according to the order quantity of the warehouse. Definition 1 is that if a certain mechanism enables military enterprises and warehouses to maximize their own returns, and both sides can obtain more benefits without harming the interests of the other party, while the entire military supply chain can also maximize the revenue, saying that the military supply chain is coordinated under this mechanism [4]. The warehouse can be considered as a strategic alliance. The optimal order quantity of warehouse i can maximize the military supply chain channel income, that is, the optimal order quantity of military supply chain channel, and the entire military supply chain income can also be reasonably distributed through φ, showing that the revenue sharing mechanism can realize supply chain coordination.

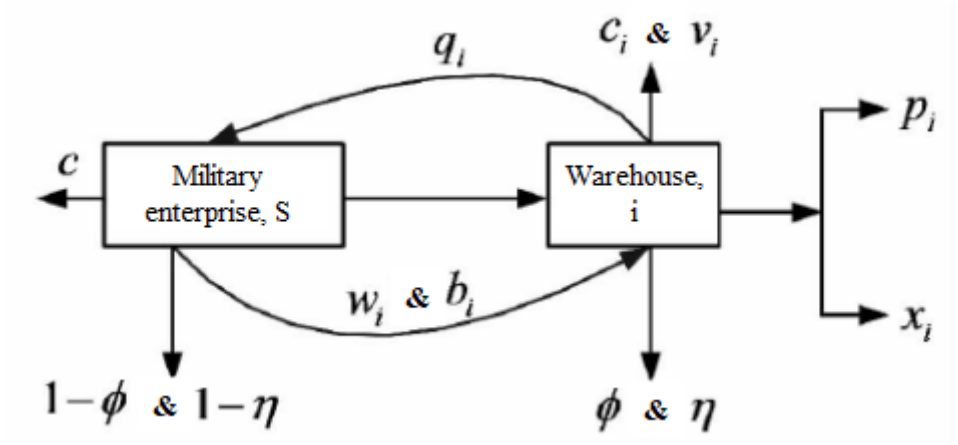


Fig 2. Decision-making process of revenue sharing mechanism

5. Coordination Model of Hybrid Military Supply Chain Revenue Sharing Mechanism

In order to reduce the burden of the i effort cost of the supply department and improve its effort level, a hybrid revenue sharing mechanism is designed based on the original revenue sharing mechanism in which the military enterprise and the supplier department i jointly bear the effort cost of supplier department i. The revenue sharing mechanism has the following provisions: according to the framework agreement of the mechanism, military enterprises are willing to share part of or compensate supplier's effort costs in an appropriate proportion, and supplier i is also willing to share its own revenue and income. The military enterprise designs a revenue sharing mechanism that supplier i can reject or accept. If rejected, the cooperation will be terminated. If the mechanism is accepted, the two parties shall reach an agreement and negotiate the relevant parameters φ and η in the mechanism. The supplier department i commits to the effort level of e_i^*, and commits to order the quantity q_i^* of products from the military enterprise [5]. According to the commitment level of the supply department i, the military enterprise shall carry out appropriate cost-sharing, and its cost-sharing ratio is (1-a), which can be selected α=φ. Military enterprises supply products to supply department i at the wholesale price wi, and recover the remaining products of supply department i at the price bi at the end of the stage, and wi=a (c-vi) +η(vi + bi) is satisfied.

6. Summary

Under the random demand of troops, revenue sharing mechanism fully considers the parameters of revenue sharing, income sharing, transfer price, recovery, and residual value. It is a combination of wholesale price mechanism, income sharing mechanism and recovery mechanism, which is more realistic, and can better coordinate the decision-making behavior between military enterprises and warehouse, distribute between military enterprises and warehouse reasonably, and is an important tool to effectively improve the operational performance of military supply chain and realize the coordination between military enterprises and warehouses. Therefore, it has certain application value in the coordination of military supply chain.

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