Study on Income Distribution Model of Container Multimodal Transport

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Abstract. The income distribution scheme is the premise of the smooth operation of enterprise alliance of container multimodal transportation. The goal of multimodal transport is to better integrate the various modes of transport organization and provide convenient transport services. The alliance enterprise puts forward the distribution scheme of self-interest from the point of view of maximizing its own income, while the multimodal transport operator guides the member enterprises to choose and modify the scheme, so that the distribution scheme can be accepted by all members. This paper analyzes the main body of income distribution on container multimodal transportation, and analyzes the principles of cooperative game income distribution, and puts forward two modes of income distribution on container multimodal transportation, and finally puts forward the distribution income scheme of container multimodal transportation.

1. Introduction
Multimodal transport is a temporary virtual organization driven by market demand. The purpose of enterprises participating in joint transportation is to obtain high economic returns. When a new alliance of multimodal transport is established, a new income distribution pattern will be produced. The formation of transport enterprise alliance is based on the fact that the enterprises participating in joint transportation can obtain more benefits than when they operate alone and achieve the goal of win-win. In the formulation of the overall distribution plan, we should respect the interests of each member enterprise, can not let the interests of each member enterprise suffer losses, so that each member can obtain higher benefits. The income distribution of container transportation is that when the enterprises participating in the joint transportation complete the transportation task, each transportation enterprise takes part of the income that each transportation enterprise should get from the total income. Because the enterprises involved in multimodal transport may be biased in the distribution of income. This may lead to disharmony and incoordination among enterprises in the whole intermodal transport system, resulting in low transport efficiency of multimodal transport. Therefore, before the transportation task of multimodal transportation begins, it is necessary to formulate a reasonable transportation scheme and distribution mode to ensure the efficient and rapid development of multimodal transportation.

2. Analysis on the main body of income distribution of container multimodal transportation

2.1. Multimodal transport operator
The multimodal transporter is the agent of the consignor, who is mainly responsible for transporting
the goods to the receiving place, and collecting the corresponding transportation expenses at the same time. According to the rationality of the transportation task, the multimodal transport operator should reasonably choose the transportation path and select the actual carrier of each section to complete the transportation task. As a core enterprise, multimodal transport operators should give full play to their own organizational and management ability, promote the whole transportation process smoothly, and provide better transportation services for consignors. The selection of multimodal transport lines and the optimization of processes, as well as the quality of transport services, determine the overall revenue of multimodal transport. Therefore, the work of multimodal transport operators determines the size of the overall income, and plays a leading role in the distribution of the overall income.

2.2. Carrier
Another subject of income distribution is the carrier. Multimodal transport operators should reasonably consider the carrier, and then make an overall plan for the transport task, and finally the multimodal transport operator and the carrier to complete the transport task together. With the development of logistics and transportation industry, many large transportation enterprises have a variety of means of transportation, in roads, railways, water transport and other aspects of their own transport lines. In addition, they also provide packaging of goods. The carrier may undertake a particular paragraph or segments of the transport task and attached value services. Because there are many uncertain factors in the transportation process, the carrier has a lot of uncertain factors in the transport process, so the resources invested and the risks taken are different. Then the corresponding income should also be different, which requires the two sides to negotiate the income distribution and formulate a satisfactory plan for both sides.

3. An analysis of the principles of income distribution in Cooperative Game
The income distribution of container multimodal transportation refers to the process of benefit distribution among cooperative enterprises of multimodal transport according to certain principles.

3.1. Individual rational principle
The fundamental purpose of enterprises to participate in multimodal transport is to obtain high economic returns, otherwise the willingness and enthusiasm of enterprises to participate in joint transport will be affected, or even withdraw. Multimodal transport enterprise coalitions with the participation of n enterprises shall meet the conditions:

\[ x_i \geq u_i \quad (i = 1, 2, \ldots, n) \]  \hspace{1cm} (3.1)

Of which:
- \( x_i \) --Represents the share of enterprise \( i \) distributed from the proceeds of cooperation.
- \( u_i \) --Represents the retained income of enterprise \( i \), that is, the income of separate operation.

3.2. Superadditive principle
The premise of using game theory as a tool to study the income distribution problem among cooperative enterprises is to meet the requirements of substantive cooperative game, that is, the cooperative income is larger than the sum of the income when each enterprise operates alone, or it will lose the possibility and premise of cooperation. That is, satisfaction:

\[ v(N) \geq \sum_{i=1}^{n} u_i \quad (i = 1, 2, \ldots, n) \]  \hspace{1cm} (3.2)

Of which:
- \( V(N) \)--Represents the maximum benefit of cooperation.
- \( u_i \) --Represents the income of the enterprise \( i \) when it operates separately.

3.3. Pareto principle
The sum of the shares of the enterprises from the cooperative income shall be equal to the total
cooperative income, that is:
\[
\sum_{i=1}^{n} x_i = v(N) (i=1,2,\ldots,n)
\]  
(3.3)

Of which:
- \(v(N)\) -- Represents the maximum benefit of cooperation.
- \(x_i\) -- Represents the share of enterprise \(i\) distributed from the proceeds of cooperation.

When \(\sum_{i=1}^{n} x_i\) is less than \(v(N)\), it shows that there is unallocated income, which is not satisfactory and acceptable to everyone. When \(\sum_{i=1}^{n} x_i\) is greater than \(v(N)\), it violates the second principle and loses the premise of cooperation.

3.4. The principle of consistency between input and income
Each enterprise involved in joint transport takes on different responsibilities in the process of intermodal transport, and their manpower, capacity and other resources for the completion of transport tasks are not the same, so they contribute to different degrees of joint transport. Their gains should also be consistent with their investments. When the other conditions are consistent, assuming that the composite index of resources for the completion of transportation input is \(w_i\) greater than the composite index of enterprise \(j\), then the return \(x_i\) of \(i\) should also be greater than the return \(x_j\) of \(j\), that is:
\[
w_i > w_j \Rightarrow x_i > x_j \quad (i, j=1, 2,\ldots,n)
\]  
(3.4)

3.5. The principle of consistency between risk and return
Consistent with the analysis of the principle of consistency between input and income, if the risk \(R_i\) of enterprise \(i\) in the course of transportation is greater than the risk \(R_j\) of enterprise \(j\) in the course of transportation, then the income \(x_i\) of \(i\) should be greater than the income \(x_j\) of \(j\), that is:
\[
R_i > R_j \Rightarrow x_i > x_j \quad (i, j=1, 2,\ldots,n)
\]  
(3.5)

4. Distribution mode of revenue on container multimodal transportation
There are three modes of income distribution among virtual enterprises: fixed payment mode, output sharing model and mixed model. The output sharing mode refers to all the enterprises participating in the cooperation, according to the determined distribution ratio in advance, to obtain their own due income from the final cooperative income. There are three modes of revenue distribution in container transportation.

4.1. All carriers are in a fixed mode of payment
Fixed payment mode refers to the corresponding remuneration paid to other enterprises in the final income by the core enterprises in the alliance. The remuneration can be paid in one lump sum or multiple times, and the core enterprise enjoys all the surplus. Under this mode, the multimodal transport operator pays the fixed remuneration to the carrier from the total cooperative income according to the contract negotiated in advance with the carrier, and the transport operator enjoys all the surplus and bears all the risks at the same time.

4.2. Some carriers are fixed payment mode, and some carriers are mixed mode
The actual carrier is divided into road, railway, waterway, aviation and other enterprises with different modes of transport, their tasks, risks and demand for capital flow are different in the process of participating in multimodal transport. It needs to be paid according to their actual needs. Therefore, in the choice of distribution mode, some implement fixed payment, others use mixed mode, first pay
them some fixed costs to complete the transportation task, and then pay a certain amount of compensation according to the risks and contributions they bear in transportation.

4.3. All carriers are in mixed mode

Hybrid model is a new model which combines fixed payment mode and output sharing model. In this model, the core enterprises pay fixed remuneration to other member enterprises, and withdraw the reward from the total cooperative income according to a certain proportion. There are too many uncertain factors in the transportation process, which lead to different risks for different enterprises in the joint transport, so it is unfair to some enterprises to adopt the fixed payment mode. In order to achieve "income sharing and risk sharing" among cooperative enterprises, most of them adopt this mode in practice.

5. Distribution scheme of container multimodal transport proceeds

It is very important to formulate a reasonable income distribution scheme to realize the income of the whole multimodal transportation enterprise and the interests of individual enterprises.

5.1. The transportation members take multimodal transport as the center of gravity

The operator of multimodal transport is the most important role in joint transport. It is first responsible for signing an intermodal contract with the owner of multimodal transport, according to which he commands the shipping enterprise and then carries it by the carrier. Transport operators should consider in advance the factors affecting the distribution of income. After considering these problems, multimodal transport operators should formulate a scientific and reasonable income distribution scheme. The income of each member enterprise of multimodal transportation reaches the maximum, and a fair and reasonable distribution scheme is worked out to meet the reasonable income of all members of the system.

5.2. Each enterprise in multimodal transport agrees on a revenue distribution plan

In the joint transport, each transport enterprise is involved in the income distribution scheme. According to the guidance of operators of multimodal transport, transport enterprises involved in multimodal transport can develop a distribution plan in advance, which may, of course, be more focused on the earnings of their own enterprises. After all, every company wants to get more revenue. In formulating the final income distribution plan, it is necessary to synthesize the schemes formulated by each member enterprise itself, and then draw some good opinions and methods of income distribution from these schemes. Finally, a more perfect total income distribution scheme is formed.

5.3. The ultimate goal of the development of multimodal transport is to maximize benefits

After the formulation and implementation of the multi-modal transport scheme, the ultimate goal is to maximize the revenue, and the same multimodal transport member enterprises can also obtain the highest return and win-win among each other. In the process of joint transportation of multimodal transport enterprises, each member enterprise should cooperate with each other, and the enterprises participating in joint transportation should make full use of their own advantages and resources and do a good job in their own transportation work. At the same time, it is also necessary to cooperate flexibly with other intermodal enterprises, to share their own information resources with other enterprises, and if other transportation enterprises do not have the resources required by their own enterprises, to share them with other enterprises. Let their transportation also achieve fast and efficient transportation. In this way, other enterprises will also share their superior resources in joint transportation, and achieve the overall cooperation and efficiency of intermodal transportation. All kinds of risks that may be faced in the intermodal transportation of each transportation enterprise can be borne by joint cooperative transportation, and the overall transportation and integrated income compensation can also be won. In joint transportation, the cooperation among members can effectively avoid the risks that enterprises need to face when they operate on their own. Therefore, joint transportation effectively
avoids the losses that enterprises have to face when they operate independently.

6. Conclusion
In order to study the revenue distribution of container multimodal transportation, we should first clarify the main body involved in the income distribution, so as to be targeted in the process of program making. Shippers, multimodal operators and carriers, as well as yard operators, play a major role in multimodal transport. Among them, the consignor does not participate in the joint transportation, is the consignor of the freight transportation, is not the object of study. The operators of each station provide service support in the process of goods circulation, but the cost is fixed, and it is not the object of study. The operator of multimodal transportation and the actual carrier of each section act as the main body of revenue distribution in this paper. The problem of revenue distribution of container multimodal transportation is analyzed quantitatively from the aspects of income distribution mode between multimodal transportation and other enterprise coalitions.

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