

Pricing Strategy of Maritime Transportation Cost Based on Revenue Management and Empty Container Theory

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ABSTRACT

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Maritime transport has become one of the most important modes transportation for foreign trade, but the unreasonable freight rate has led to the vicious competition among maritime transport companies. This paper aims to help the maritime transport company maximize profits. For this, revenue management and empty container theory were applied to explore the cost pricing strategy of maritime transport process, and a transportation pricing model considering empty container theory was established using MATLAB. The research results show that the main purpose of maritime transport companies is to maximize benefits and satisfaction of owners. The pricing of transportation costs for maritime transport companies involves the formation and supervision of pricing strategies. Transportation costs, subjective value of owners, arrival rate of owners, and changes of the initial container slot allocation all will affect the optimal pricing of maritime transport cost. The research findings provide a theoretical basis for studying the pricing of marine transportation costs.

ADDITIONAL INDEX WORDS: *Maritime transport, revenue management, empty container theory, transportation costs, pricing strategy.*

INTRODUCTION

Maritime transport has a nonnegligible influence on the foreign trade economy. With the acceleration of economic globalization, China's foreign trade has grown rapidly, resulting in an extension of the economic hinterland of coastal ports. China's port throughput has shown an upward trend year by year (Lee, Hu, and Chen, 2010). In addition to a large volume and long-distance adaptability, maritime transport also has the advantages of safety, environmental protection, and energy saving. Thus, according to incomplete statistics, more than 80% of China's foreign trade volume is completed by maritime transport (Claireaux, 2006). Revenue management is a micromanagement tool that centres around capturing the revenue opportunity of the market and realizing the effective allocation of resources through dynamic forecasting, so that the production capacity of marine transport companies matches the market demand (Bakalar, Baggini and Bakalar, 2017).

During the maritime transportation process, the organizers do not directly access to the transport capacity resources. The resource allocation process generally includes two parts: the actual carrier-oriented transport resources purchased and the owner-oriented transport capacity distribution (Tesfay, 2014). Revenue management and empty container theory in maritime transport refers to the use of scientific decision-making theories and means such as forecasting and optimization to load the largest freight at the most appropriate price, thereby

obtaining the maximum benefit (Azadian and Murat, 2017). Pricing strategy in maritime transport is actually the management of prices and container slots (tonnes), ensuring that each slot in each area of the cargo ship is sold at the optimal price (Wadud, 2015). Based on revenue management and empty container theory, this paper explores the cost pricing strategy of maritime transport in order to obtain the maximum benefit.

FACTOR ANALYSIS FOR THE REVENUE MANAGEMENT OF MARITIME TRANSPORT

Figure 1 shows the freight volume and turnover of China's maritime transport in recent years. It can be clearly seen that China's maritime freight volume shows a year-on-year growth trend; it was nearly doubled in 2018 compared with 2011. Aimed at ultimately maximizing the profits, revenue management values prices over costs when focusing on the balance between supply and demand, and values the market over costs when setting the price (Wadud, 2014). The revenue management of maritime transport refers to the use of scientific decision theory and means such as forecasting and optimization, to timely and effectively manage the freight price and freight quantity by freight transport companies, so as to ensure the profit maximization of each shift and achieve the maximization of the maritime transport revenue (Chi and Baek, 2012). It can be expressed by a mathematical model, where W represents the total expected revenue value. The calculation formula is shown as:

$$\text{Max } W = \sum_i W_i \quad (1)$$

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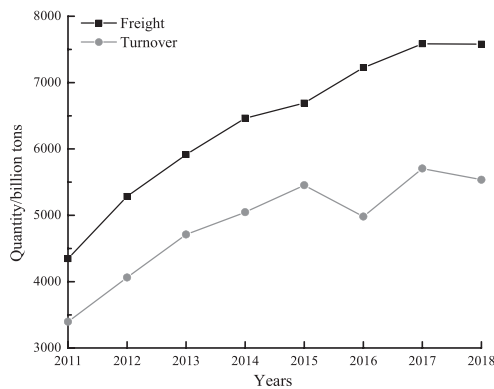


Figure 1. Freight volume and turnover of marine cargo in China in recent years.

$$W_i(m_i) = f_i \times n_i(m_i) \tag{2}$$

where:

W_i is the expected revenue value of the slot at the i level of freight rate;

$n_i(m_i)$ is the expected order quantity for the i level of freight rate;

m_i is the number of slots allocated at the i level of freight rate.

The main purpose of maritime freight transport companies is to maximize benefits and satisfaction of owners. It is necessary to consider the impact of empty containers on transportation costs. In addition to selecting the shortest transportation route, one should also fully consider the transportation cost of heavy container, storage costs of empty containers, allocation costs, etc., as well as the influence of empty containers on the transportation cost. The satisfaction of the owners is not only affected by the service attitude, but also depends on their own value. Therefore, transportation pricing is an important factor affecting both the marine transport companies and owners.

PRICING ANALYSIS OF MARITIME TRANSPORT COST

The main factors affecting the revenue of marine freight companies include transportation cost, pricing, capacity, and owners' demand, and the first three directly determine their income. There are many freighter shipping companies in China, and the pricing methods for transportation costs of different companies are similar. Many large freight companies adopt centralized management of the transportation pricing. The pricing system of maritime transport is complicated. In addition to the basic freight rate, it also includes some specific fare increases, specific route charges, and various miscellaneous or service fees. At present, marine transport is charged by the freight company mainly in two ways, namely, by volume and by weight (tonnage). However, the volume-based charge is relatively uneconomical for the owner with empty containers; the weight-based charge may result in a decline of the freight company's profit due to the large volume of goods and low freight rate.

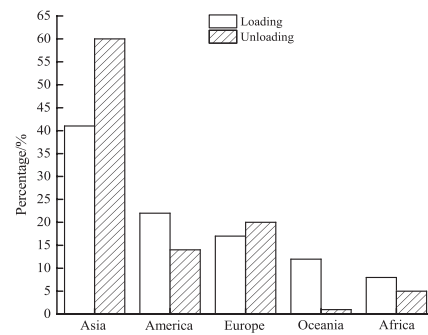


Figure 2. China shipping company's shipping loading and unloading share in different regions in 2018.

Figure 2 shows the loading and unloading share of China's maritime transport companies in different regions in 2018. The figure shows that the proportion of loading and unloading of those companies varied in different regions in China, indicating that the maximum profit cannot be realized in each shipping process. Under the conditions of market economy, the transportation price is an important factor for the owner to choose the transportation mode. If the pricing cannot adapt to the changes of objective economic conditions, the rational allocation of transportation resources will not be realized. The diversity of maritime transport determines that freight companies must form a diversified and flexible pricing method for transportation costs, in order to develop three pricing strategies: government pricing, government-guided pricing, and pricing of maritime transport companies.

MARITIME TRANSPORT PRICING MODEL CONSIDERING EMPTY CONTAINER THEORY Model Construction

At present, maritime freight transport does not have a monopolistic advantage. However, with the increasingly fierce competition in the ocean transport market, many marine freight transport companies urgently need to increase revenues based on the revenue management theory. Figure 3 shows the joint decision of container shipping pricing and container slot allocation. The whole shipping process can be divided into two stages: the first stage is to negotiate the container slot allocation according to the container capacity agreement of the freighter and the sales agreement of the owner; the second stage is to determine the pricing and slot allocation based on self-seeking prediction and demand forecasting. For maritime



Figure 3. Joint decision description of container maritime pricing and container slot allocation.

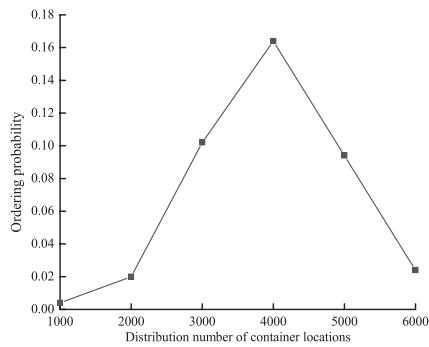


Figure 4. The relation between ordering probability of container location and slot allocation of freight ships.

transportation, the initial transportation cost pricing will affect the ordering ratio of the owners, and will only be considered when the owner's subjective value is greater than the transportation cost pricing. Figure 4 shows the relationship between the ordering probability of the container slot and the slot allocation. As the number of the cargo slot allocation increases, the ordering probability of the owner increases first and then decreases.

Numerical Analysis

Both too-high or too-low prices of shipping transportation costs affect the expected profit of freight companies. The change

in the price of empty containers has a great impact on the purchase intention of cargo owners. In order to better analyse the impact of various variables on the optimal pricing, this paper studies the impact of transportation costs, subjective values of owners, arrival rates of owners, and changes in initial container slot allocations on optimal pricing. Considering the complexity of the actual operation, MATLAB numerical simulation was used to explore the powerful mathematical calculation function for numerical solution and parameter comparison. Figure 5 shows the influence of various factors on the optimal pricing of marine transportation costs. Figure 5a shows the transportation cost factor. The transportation cost has a positive linear relationship with the optimal pricing. Figure 5b is the subjective value factor of the owners, indicating that with the increase of the owner's subjective value, the optimal pricing of maritime transport costs also gradually increased, with an increasing growth rate. Figure 5c shows the arrival rate of owners, in which the higher the owner arrival rate, the higher the transportation cost was set by the freighter transport company. When the arrival rate was 10–30, the optimal pricing varied little; when it was greater than 30, the pricing of freight transport company's transportation cost increased rapidly. Figure 5d shows the changes of the initial container slot allocation. It can be clearly seen that the allocation of the container slot at the beginning of the period was not the more the better. With the increase of the initial container slot allocation, the pricing of the transportation cost

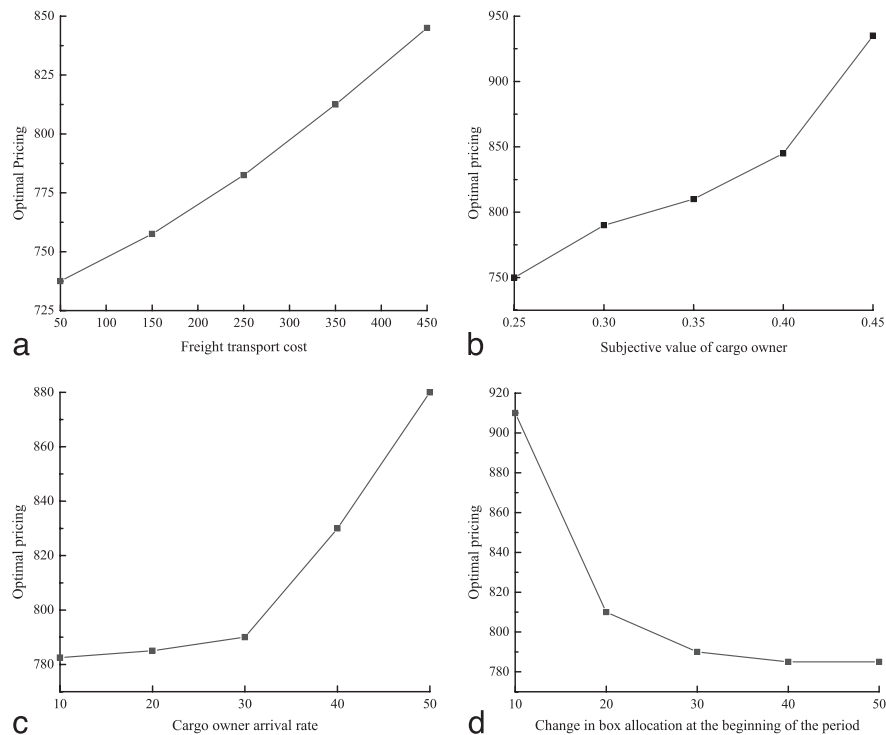


Figure 5. Influences of various factors on optimal pricing of maritime transportation costs. (a) Transportation cost; (b) Subjective value of cargo owner; (c) Freight arrival rate; (d) Change in initial container slot allocation.

by the freighter company first dropped rapidly and then stabilized.

CONCLUSIONS

Based on revenue management and empty container theory, this paper aims to explore the cost pricing strategy of maritime transport for benefit maximization. The specific conclusions are as follows:

The main purpose of the maritime transport company is to maximize the benefits and the satisfaction of the cargo owner. In the transportation process, it should consider the impact of the empty container on the transportation cost, as well as the transportation cost of heavy container, storage costs of empty containers, and allocation costs, *etc.* in addition to selecting the minimum transportation route.

The diversity of maritime transport determines that freight companies must form a diversified and flexible pricing method for transportation costs. Three pricing strategies are developed: government pricing, government-guided pricing, and pricing of maritime transport companies.

The transportation cost, the subjective value of the owner, the arrival rate of the owner, and the change of initial container slot allocation all have an impact on the optimal pricing of the maritime transport.

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