

A Pricing Method for Small-size Cargo Express Service in Long Distance Highway Transportation

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Abstract: After a survey of 10 long-distance highway passenger transportation stations in Beijing, we found that 50% of the stations do not provide express services for small-size cargo. Passenger stations that provide such services have a low profit. The main reason is that there is no effective pricing method for small-size cargo express services. To address this issue, we first looked at the operating costs of all the parties involved in small-size cargo express services. According to the customers' freight transport demand function, we propose a model for determining the price of small-size cargo express services with an objective function of maximizing the starting station's revenue. Based on the model, necessary conditions are specified in order for passenger stations and companies to operate such businesses. Furthermore, a method of fitting the transportation demand function is provided based on actual operations and services. Finally, a numerical example is given to illustrate the application of the proposed pricing method for small-size cargo express services.

Key Words: highway transportation; pricing method; operating cost; small-size cargo express; transportation demand

1 Introduction

Small-size cargo express services are part of the highway long-distance passenger transportation services. To obtain the highest profit, highway passenger transportation enterprises make use of the bottom storage space of intercity passenger buses to carry out small-size cargo express services. As shown in the Ref. [1], Greyhound, the biggest highway long-distance passenger transportation company in America, belongs to this category. Its small-size cargo express service revenue accounts for about 15% of their total revenue, thus small-size cargo express services play a significant role in determining the overall profit of highway long-distance passenger transportation enterprises.

After a survey of 10 highway long-distance passenger stations in Beijing, we found that 50% of the passenger stations did not provide express services for small-size cargo. The passenger stations which carry out this service have a low profit, having only two passenger stations that are well managed. Further analysis shows that passenger starting stations lack of a method to establish adequate freight rates. If the price is too high, shippers will not use the services, which thus will reduce the revenue of the station. On the other hand,

if the price is too low, the profit may not be high enough even though the demand generally increases. To obtain an appropriate profit, starting stations can only raise the price of handling small-size cargo, which results in higher handling fees compared with freight rates, causing the impression of arbitrary charges to the shipper.

With regard to the theory and method of establishing freight rates, Jia *et al.*^[2] provided a comprehensive review of the existing methods, including average cost pricing, marginal cost pricing, full-cost pricing, and so on. However, after retrieval of relevant literatures, pricing of small-size cargo express services does not exist. As discussed above, establishing an adequate freight rate for small-size cargo express services has a practical significance to make full use of the transport capacity to meet the demand of cargo express businesses in different regions and to promote the development of regional economy.

2 Analysis of parties involved with in small-size cargo express services

Zhang *et al.*^[3] pointed out that the highway passenger transportation forms a business model for separating

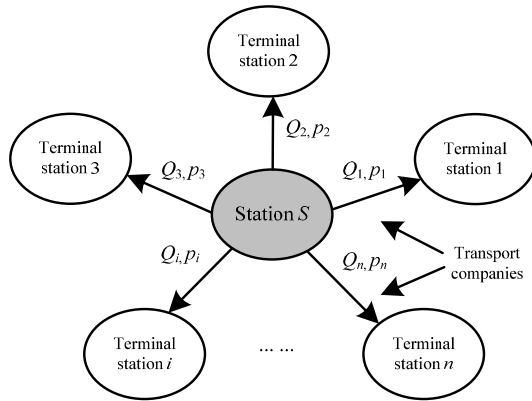


Fig. 1 Illustration of long-distance passenger station (S) terminals, freight volumes, and rates

passenger stations from transport companies with the rapid development of highway passenger transportation and reformation of management systems in China. This implies that highway passenger stations and companies are independent market participants, although they are also considered partners. Highway passenger and cargo transportation is the earliest transportation mode to implement the full market competition mechanism.

Therefore, small-size cargo express services involve multiple parties such as long-distance passenger stations, transport companies and so on. Fig. 1 shows the relationship among relevant parties involved. Successful small-cargo services should consider the benefits of all the parties involved.

3 Cost analysis of small-size cargo express services

Because all the parties involved in small-size cargo express services are independent market participants, each party's cost and income should be considered. If any party's anticipated profit is not met, this business will not be able to continue.

3.1 Cost for highway long-distance passenger stations

The stations include the starting and terminal stations.

(1) Cost for starting station S

Starting station S is responsible for the market development and organization of the source of cargos. In addition, starting station S is also responsible for cargo security, weight or volume measurement, fee collection, and cargo storage.

The cost involved with starting station S includes the construction cost of the warehouse infrastructure and staff offices, expenditure of security checks, fire control, monitoring, weighing, handling and packing equipment, and computer management system. The cost also includes staff salaries, benefits, bonuses, daily office expenses, depreciation and maintenance costs, and taxes. The expected earnings from small-size cargo express services are denoted by C_S (yuan/year).

$$C_S = \sum_{j=1}^m c_{sj}, \quad j = 1, 2, \dots, m \quad (1)$$

where c_{sj} is the j -th input cost that is spent by starting station S carrying out this service, m is the total cost that is spent by starting station S.

(2) Cost of terminal stations

The responsibilities for the terminal stations are relatively simple. Without the need for any hardware costs, it mainly involves the delivery of the cargo to the recipients, which can be handled in various ways. Thus, the cost and expected earnings are relatively low, thus they can be included in the overall cost of the highway long-distance passenger transportation companies or they can be ignored.

3.2 Cost of long-distance passenger transport companies

The main business of long-distance passenger transport companies is transporting passengers. Thus their operating costs (salary and welfare, fuel, warranty fee, tire wear, depreciation, transportation management fees, vehicle tax, accident cost, etc.)^[4] are included in the ticket price. Using intercity passenger bus bottom storage space to carry small-size cargo, the expenditure cost is simply the increased fuel consumption which results from the increase in weight and load distance. Because the competition occurs on the same route, the unit cost and the expected earnings of all transportation companies are the same. Hence, the unit transportation cost of the cargo between starting station S and terminal station i and the unit cost of the delivery from the terminal station i are constant, and is denoted by c_{iv} (yuan/kg·km). Every route's unit transportation cost is obtained from starting station S.

$$C_v = (c_{1v}, c_{2v}, \dots, c_{iv}, \dots, c_{nv})$$

4 Loss analysis of starting stations

From the analysis of parties involved with small-size cargo express services, highway long-distance passenger starting stations play a critical role in establishing freight rates in all companies of serving shippers. First, passenger stations consult with transportation companies of every route to obtain the unit freight rate (transportation cost and expected earnings) of the transportation company. Second, the cost and expected earnings of the passenger station are calculated by summing the cost and expected earnings of the two parties, providing a win-win situation for both parties. Finally, a freight rate is given to the shipper. However, in practice, the passenger starting station made a loss and did not continue to operate. That is because there were two misunderstandings when the freight rate was established.

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