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Research on Railway Freight Market Share Based on the Whole Process of Transport

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Abstract

This paper develops a mathematical model to quantify the market share of given freight transport corridor. By analysing the whole process of door to door freight transport, the generalized cost model of railway and highway is established, respectively. A case study of long-distance transport in China's inland cities is subsequently conducted to explore market share of railway and highway. At last, the sensitivity of influence factors is analysed. We find that the average train speed, waiting time to be loaded, container volume and transport distance can significant affect the railway market share. The railway market share increases as the average train speed, container volume and transport distance increase, while decreases as the time waiting to be loaded increases. When the average trains speed is over 50 km/h, or the time waiting to be loaded is less than 1.5 d, railway market share is over 50%. Moreover, railway is more competitive in high capacity and long-distance freight transport. We also find that the result of single factor's change is limit, while the change of multi-factors can affect the railway market share greatly.

Keywords: freight transportation; generalized cost; Logit model; market share; transport process

1. Introduction

Railway transport has many advantages which highway, waterway and air transport are incomparable, such as safety, high-speed, long distance, large capacity, little pollution, little effect by weather and so on. While the market

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share of railway freight transport has declined from 14.6% in 2004 to 8.9% in 2013, decreasing by 0.57% per year on average (NBSC, 2014). Therefore, it is necessary to study the railway competitiveness among multiple transportation modes in transportation corridor and analyse the factors influencing the railway market share. The results may provide theoretical basis to improve the railway transport services and raise the railway market share.

There has been much literature on the competitiveness of railway transport, which concentrated more on rail passenger transport (Xu and He, 2008; Ye and Wang, 2010; Cao and Cao, 2011). There were few researches on the railway freight market share, Chen (2012) used Logit model to calculate the market share between highway and railway, Ye (2013) studied the market share of the Guangzhou-Shenzhen railway freight transport based on Influ-Logit model. The researches on freight had more concentration on the multiple factors when choosing the transport mode. Cost, time, reliability, security, punctuality, speed, convenience and other factors were analysed when choosing the railway in freight transport (Pierre and Dominique, 2004; Romeo and Edoardo, 2005; Nikolaus and Zachary, 2008; Chen, 2012). Allan (2006, 2007) investigated the railway market share from policy, carrying out multimodal transport and expanding break bulk cargo transport. However, some factors above are cross and overlapping, and a large amount of data is needed for calibration, which have poor reliability when analysing the railway transport market share. However, the reliability could be improved while calculating the railway transport market share from the time and cost of the whole transport process in freight transport.

In this paper, a generalized cost function of railway and highway is established based on the analysis of the whole process in door-to-door freight transport. The share rates of the two modes are calculated according to improved Logit model. Furthermore, taking the long-distance freight transport among China's inland cities for example, the railway freight market share and its influence factors are analysed. At last, the development strategy for raising the railway freight shares is proposed.

The rest of this paper is organized as follows. Section 2 analysed the transport process of rail and road freight transport. In Section 3, the generalized cost function and market share calculation model are presented. A case study and sensitivity of the influence factors are investigated in section 4. Finally, the conclusions are given in the last section.

2. Analysis of rail and road transport process

In long-distance inland transport, road and rail are the main modes, so this article considers only road and rail in freight transport. The main process of road transport and rail transport is shown in Figure 1.
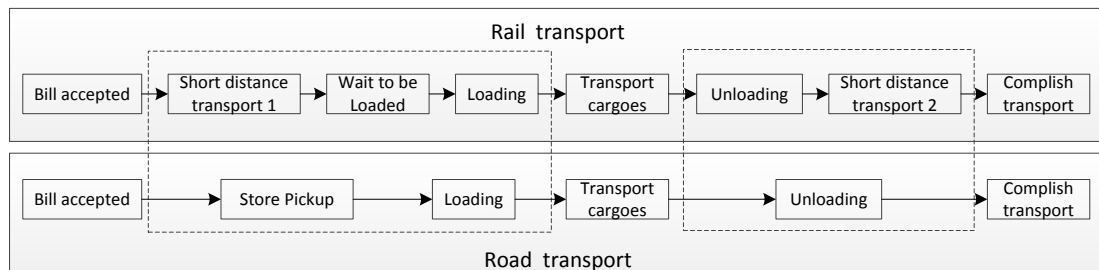

Fig.1. Rail and road freight transport processes

In railway freight transport, road transport is often required in the beginning and the ending of the whole process to achieve door-to-door. After the transport applications are submitted, cargoes will be transited to freight station by trucks (short distance transport 1), then they will be loaded in the freight station (including procedures handled and accumulation of freight trains). After loading, the cargoes will be transported by railway, during which vehicles may be regrouped. At last, the cargoes will be unloaded in terminal station, and then they are transported to destination by trucks (short distance transport 2). In this paper, we simplify the process of handling procedures and accumulation of freight trains into the step of "wait to be loaded", the process of trains regroup is simplified into "transport cargoes".

In road freight transport, the loading and discharging of cargoes only need once while transporting. When the