The 9th International Conference on Traffic & Transportation Studies (ICTTS'2014)

Analysis of Urban Public Transit Pricing Adjustment Program Evaluation Based on Trilateral Game

Huawei Gong[a,b], Wenzhou Jin[a,*]

[a] School of Civil Engineering and Transportation, South China University of Technology, No.381 Wushan Road, Tianhe District, Guangzhou 510641, P.R. China
[b] School of Civil Engineering, Guangzhou University, Panyu University City Outer Ring Road No.230, Guangzhou 510006, P.R. China

Abstract

Establishment and implementation of the urban transportation pricing adjustment program will have great impacts on holistic development of urban transportation. The paper establishes a trilateral game model on pricing adjustment program participants, including governments, public transport enterprise and passengers. Through analyzing trilateral benefits, the model can conclude if an adjustment program succeeds or not. Furthermore, adopting the modeling method of Stackelberg oligopoly model, applying backward induction method in model analysis, the model presents an evaluation method for estimating whether the public transit pricing adjustment program is successful or not. The work provides a research method for studying the feasibility of an urban transportation pricing adjustment program.

Keywords: Public Transit Pricing; Program Evaluation; Trilateral Game; Backward induction

1. Introduction

In large or middle-scale cities of China, traffic congestion becomes increasingly serious. To develop the public transport and inhibit the private transport, as well as to advocate the concept of public transport priority, can be deemed as necessary measures for improving traffic conditions. There are many ways to develop public transport, especially, reducing the cost of bus travel, which is becoming one of the most important way. For example, since

---

[*] Corresponding author. Tel.: +86-139-2215-6885, Fax: +86-(0)20-8711-4460.
E-mail address: ctwzhjin@scut.edu.cn

2007, in Beijing, the municipal government reduced an ordinary bus ticket price to 0.4 yuan per trip, subway ticket price reduced to 2 yuan per trip. With other bus priority measures, in 2009, the proportion of public transport in Beijing increased by 10.7%, thus reached 38.9%, comparing with which in 2003.   Furthermore, in 2010, in Guangzhou, a public transit pricing adjustment was executed, which was, in a natural month, when a passenger took bus or subway using the same Yang Cheng Tong card more than 15 times accumulatively (Metro and bus ride could be accumulated equivalently), from the 16th bus or subway ride, he could get a 40% discount each ride for the rest of that month.

Involving the interests of many aspects, urban public transit pricing adjustment program is a complex task. The quality of adjustment program will have direct impact on the effect of the implementation. In fact, whether increase the taxi fare or reduce bus fare will always cause widespread social debate. So the feasibility of the adjustment program should be studied carefully.

For public transport pricing program development and adjustment, the most commonly method is technical economics analysis, with emphasis on profit. Although this method satisfy the economic rules, frequently a higher pricing program will be formulated and the affordability of the residents often be ignored. When the public does not accept this pricing program, the proportion of public transport use will decline, the city's overall traffic conditions will get worse. On the contrary, some cities, such as Beijing enacted a significant reduction in the cost of public transport schemes, although it greatly improved the proportion of public transport use, but government must invest a lot of financial subsidies, and it is not realistic for most cities. In the previous studies of public transport pricing scheme, using Game Theory model for analysis is not uncommon. The researchers established the game model of public transport and private transport, or public transport user and public transport manager game theory model to determine a reasonable ticket price of the program. The relationship between public transit demand and total travel demand has been studied (Bian and Lu, 2009) according to the ticket prices. Logit model is used to establish the mode split in public transit system. Then the profit functions of both firms are presented. Based on the profit functions, a price game model is provided to discuss the competition between urban railway and bus. The existence and computing method of the Nash equilibrium price solutions are proposed. The conclusions of this research are useful to managers for their operations with urban public transit system, but this study didn't pay attention to the benefit participant role in ticket pricing. The constitutions and characteristics of urban public transit system was introduced (Wang, 2008), then expatiated some principles about the price of public transit. On the basis of summarization of the pricing and subsidy principles, the game theory has been established in ticket pricing and subsidy of urban public transit. Although the study had analyzed the relationship between the three participants, and based on cooperation and non-cooperation game model, public transportation enterprise pricing model are established respectively, but she didn't establish trilateral model to analyze the problem. Game theory model were established in analyzing the traffic model choice or ticket pricing (Chen and Luo, 2005; Chen et al., 2010; Wang and Chen, 2008). A tri-level programming is presented in order to seek the optimal passenger transport price while the benefits of passengers and transport departments are both considered under the condition of market competition between different transport modes (Si and Gao, 2007). In our work, we establish a game theory model of the main pricing program participants as players-- the government, public transport enterprise and passengers. Through benefit analysis we get the game equilibrium conditions, that is the basis for us to judge program success or not.

2. The Tripartite Benefit Analysis of Public Transit Pricing Adjustment Program

The public transit pricing adjustment program mostly formulated by government in China. According to China's metropolitan public transport services and pricing policy, we believe that the main participants include three categories of government, public transport enterprise and passengers, analyzing the benefit relations of tripartite participants as follows:

Firstly, the role of government. The primary purpose of government is to achieve the maximization of social welfare in public transit pricing adjustment. As public transport manager, the government want to provide good conditions to meet the travel demand of the passengers, keep the cost of public transit in a reasonable level, and provide financial subsidies to public transport enterprises. On the one hand the government need to lower fares to make more proportionate use of public transit, on the other hand government should provide public transport enterprises for a certain degree of financial subsidies, so that the bus enterprises can get a better economic benefits.