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Rationality of fare increment for improvement of transfer facilities at metro stations: An experience in Kolkata

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ABSTRACT

There are several lacunas associated with the public transport quality and allied facilities in emerging countries such as India. The improvement of these facilities is a major challenge as most of the Governments are not only finding it difficult to provide an additional subsidy for the improvement but are also hesitant to increase the fare because of socio-political reasons. In this context, the present paper demonstrates an approach for investigating the rationality of fare increment with reference to a case study of transfer facilities at metro stations in Kolkata city, India. Rationality of the fare increment is judged by comparing the fare increment with (i) benefits likely to be transferred to commuters due to improvement, (ii) present fare, and (iii) average daily income of metro commuters. The work also highlights the need for quantifying the benefits likely to be transferred to commuters from the proposed improvements for relating the fare increment to derived benefits. It is shown that if the fare increment is found rational then facilities should be developed by recovering the associated cost from commuters without putting the additional financial burden on the Government. The Government subsidy should be introduced only when it is required to bring down the fare increment to a level which is considered rational. The findings will hopefully encourage policy makers to apply the approach to other contexts for improvement of transport facility or quality of service with a rational increment of fare and use of Government subsidy, as and when required.

1. Introduction

The need for improving public transport is well recognized by transportation professionals and policymakers in emerging countries such as India which is experiencing rapid urbanization and extensive growth of travel demand (MHA, 2011; MoRTH, 2013). Accordingly, several initiatives have been taken up in the recent years by various Governments for promoting public transport in urban India through policies and actions (MoUD, 2011, 2006). While efforts have been made for improving bus system in urban areas, several metropolitans such as Kolkata, Delhi, Bengaluru, and Mumbai have also implemented metro rail system as an efficient and eco-friendly mode of transport for providing relief to the city dwellers from road congestion, emissions and economic loss (Maitra and Sadhukhan, 2013).

The role of transfer facilities in and around metro stations is important as metro rail does not provide 'last mile connectivity'. The prominence of transfer facilities at multimodal stations and rail stations has been highlighted by several researchers (Alshalalfah and Shalaby, 2007; Brons et al., 2009; Dell'Olio et al., 2011; Liao et al., 2013). The role of transfer facilities around public stations has been acknowledged by the Transportation Research Board (TRB, 2012). The importance of transfer facilities around transit stations has also been recognized in the *'Station Area Access Planning Manual'* developed by Washington Metropolitan Area Transit Authority (WMATA, 2008). Unfortunately, there are noticeable lacunas associated with transfer facilities at several metro stations in the context of developing countries such as India. These deficiencies primarily relate to qualitative aspects. For examples, in the majority of metro stations, the adequate travel information especially the directional information and feeder service route related information are absent, crossing the road near the proximity of the metro stations are often found unsafe because of no pedestrian phase or zebra crossing and the condition of pedestrian facilities are not commendable as the available sidewalk is either missing or encroached by hawkers. While transfer facilities at metro stations are deficient, a recent study carried out by Sadhukhan et al. (2014) indicates that these are considered important by metro com-

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muters. In fact, the importance of several transfer facility attributes is found higher than the direct cost or the fare. Subsequently, Sadhukhan et al. (2016) reported a variation of WTP values for improvement of transfer facilities across various segments of metro commuters in Kolkata city based on socioeconomic and trip characteristics. All these works justify the need for further investigations to find out a rational approach for improvement of transfer facilities at metro stations giving due considerations to related policy issues such as fare increment to commuters, subsidy from the Government, etc.

It has been observed over time that the public transport is generally subsidized in urban India and the fare is kept low in order to make the service 'affordable' to all economic sections of the society. However, the subsidy is often restricted and therefore, the focus of the Government has been on maintaining or continuing the present service (say, running the buses or trains) without giving due attention to the quality of service (say, type of coach or vehicle, comfort, etc.) and development of allied facilities (say, transfer facilities, traffic information, etc.). On one hand, most of the Governments are finding it difficult to sustain the load of the present subsidy on public transport. On the other hand, several Governments are hesitant to increase the fare because of socio-political reason. How to improve transport facilities or systems in such a condition is a major challenge faced by transportation professionals and policymakers in emerging countries such as India.

The present study aims to find an approach to improve transfer facilities at metro stations without putting the undue burden to the Government (in terms of additional subsidy) and commuters (in terms of fare increment). Accordingly, the present work reports an investigation on the rationality of fare increment in lieu of the improvement of transfer facilities and resulting benefits to the commuters. Rationality of fare increment is judged by comparing the fare increment with (i) benefits likely to be transferred to commuters, (ii) present fare, and (iii) average daily income of the commuters. The approach for investigating the rationality of fare increment is demonstrated with reference to a case study of transfer facilities at metro stations in Kolkata city which is one of the metropolitans in the eastern part of India with a population about 4.49 million (MHA, 2011). The existing metro system in the city serves an average of 0.543 million passengers each day with an operational length of 27.217 km and 24 stations (IRPCMST, 2012). In order to carry out the present study, a stated choice (SC) survey instrument was designed and data were collected by intercepting metro commuters of Kolkata city. The collected information was suitably coded in a digital database and analyzed by developing a multinomial logit (MNL) model. The coefficient estimates of the MNL model were used to calculate the willingness-to-pay (WTP) values and perceived benefit to users for improving transfer facilities at metro stations. The required fare increments for improving transfer facilities are calculated considering the installation, operation and maintenance costs over the life cycle. This analysis was carried out for several scenarios formulated on the basis of sharing of the installation cost between the Government (in terms of additional subsidy) and metro commuters (in terms of fare increment). The rationality of the fare increment was investigated by comparing the same with the perceived benefit, present fare, and commuters' average daily income.

The paper is organized into five sections. Section 1 highlights the context and motivation of the study while Section 2 discusses the perceived benefit to users/commuters due to the improvement of one or more transfer facilities at the metro station. In Section 3, the several strategies for improvement of transfer facilities under various cost-sharing (between the Government and the commuters) scenarios and resulting fare increments (considering user benefits and life cycle cost of improvements) are reported. Rationality of the fare increment subject to perceived benefit, present fare and average daily income of the commuters are discussed in Section 4. Finally, major conclusions drawn from the present study are summarized in Section 5.

2. Estimation of users' benefit

In order to estimate the likely benefit to commuters resulting from improvement of transfer facilities, a survey instrument was designed to collect data from metro commuters and the database was analyzed by developing a multinomial logit (MNL) model. The database used in the present work is same as reported by Sadhukhan et al. (2016) in the context of investigating the effect of socioeconomic and trips characteristics on WTP values. However, a brief outline of the survey instrument and the database is included below in the context of the present paper.

2.1. Design of survey instrument

A paper-pencil based questionnaire was designed to collect responses from metro commuters through a face-to-face interview. The languages selected for the questionnaire were English and Bengali (local language in the Kolkata city) to intercept more commuters during the survey. An online version of the questionnaire was also circulated in parallel among metro commuters having internet access in order to reduce the time and the complexity of getting on spot user survey. However, the number of the online responses was very few as commuters in Kolkata are not found interested in filling the online form. Although, both revealed preference (RP) and/or stated preference (SP) data have been used by researchers (Hensher, 2008; Hensher et al., 2008, 2005; Louviere et al., 2000; Louviere and Timmermans, 1990; Sadhukhan et al., 2016) for valuation of attributes or estimation of willingness-to-pay (WTP), in the present context SP was preferred over RP as several attributes levels were non-existing and thus RP data was found inappropriate. Moreover, SP-based models are well established for the purpose of valuing of attributes (Hunt, 2001; Iraguen and Ortúzar, 2004). Although SP data may be collected in the form of rating, ranking and choice, in the present work discrete choice experiment (DCE) was adopted due to its strong theoretical foundation (Louviere et al., 2000). The selection of transfer facility attributes was done in two steps. In step one, a list of transfer facility attributes was prepared on the basis of reconnaissance survey, review of the literature, discussion with experts and metro commuters. In step two, a rating based analysis was performed to understand the commuters' perception towards the importance of transfer facility attributes and derive the ranks (Sadhukhan et al., 2014). On the basis of this analysis, attributes used in the present study were selected. Keeping in mind the existing condition, possible practical alternatives, and available literature, attributes' levels were decided. Attributes and their levels used in the present study are shown in Table 1.

In order to reduce the size of the experiment design for the present study with six attributes and three levels for each attribute (except metro fare having four levels), the optimal design was found instrumental over full factorial and fractional factorial designs. As no prior information was available in the context of the present study, an unlabelled D-optimal design (with D_z error) was used to generate a total of 48 choice sets in 8 blocks (Demirkale et al., 2013; Jafari, 2010; Rose et al., 2008). A total of 6 choice sets were composed in a single questionnaire considering the response fatigue. A sample choice set is shown in Fig. 1.

2.2. Data collection and database development

The stated choice (SC) data were collected by intercepting metro commuters at 20 metro stations in the Kolkata city during January-May 2013. First, commuters were asked to provide their socioeconomic and trip characteristics related information. Then they were informed about relevant transfer facility attributes through brief descriptions with pictorial illustrations and finally requested to select options from