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## Commuters' willingness-to-pay for improvement of transfer facilities in and around metro stations – A case study in Kolkata

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### ABSTRACT

Although several cities in India are developing the metro system, there are lacunas associated with transfer facilities in and around metro stations. The present work aims to investigate the perception of commuters of Kolkata city, India in terms of their willingness-to-pay (WTP) for improvement of transfer facilities. A stated preference survey instrument was designed to collect choice responses from metro commuters and the database was analysed by developing random parameter logit (RPL) models. The decomposition effects of various socioeconomic and trip characteristics on mean estimates were also investigated in random parameter logit models with heterogeneity. The work indicates significantly high WTP of metro commuters as compared to the average metro fare for improvement of various qualitative attributes of transfer facility such as 'facility for level change', 'visual communication', 'pedestrian crossing', and 'pedestrian environment'. The WTP values are also found to vary across different groups of commuter formed on the basis of 'trip purpose', 'monthly household income', 'station type' and 'metro fare'. 'Work trip' commuters are found to have higher WTP for improvement of access time, pedestrian environment and use of an escalator over the elevator. On the other hand, 'high-income group' commuters have shown higher WTP for improvement of access time, pedestrian crossing, and pedestrian environment. While 'high fare group' commuters have higher WTP for access time and pedestrian environment, heterogeneity is also observed in WTP for facility for level change, pedestrian crossing, and pedestrian environment across commuters using different 'station type' (underground, at-grade, and elevated). The findings from the study provide a basis for formulating policies for the improvement of transfer facilities in and around metro stations giving due attention to the preference of commuters having different socioeconomic and trip characteristics.

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## 1. Introduction

Rapid urbanization and momentous growth of private vehicle ownership are intensifying the travel demand in urban India (MHA, 2011; MoRTH, 2013) where the road capacity augmentation in urban areas is also often restricted by space constraints. These create an imbalance between the demand and the supply of transport infrastructure. The growing imbalance

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is aggravating traffic congestion and vehicular emissions in urban areas and becoming a daily hurdle for urban dwellers (Maitra and Sadhukhan, 2013). In this context, the need for improving public transport patronage is well recognised by the Governments, transport planners, and researchers. The Government of India and several State Governments have already been taken up several initiatives to uplift the public transport usage and thereby cater down the private vehicle shares in urban areas (MoUD, 2014). Although, bus is the predominant mode of public transport in the majority of Indian cities because of its 'low fare' and 'flexibility', megacities such as Kolkata, Delhi, Bengaluru, and Mumbai have also developed metro rail as an 'efficient' and 'eco-friendly' mass rapid transit system (MRTS) to increase public transport patronage. A few more cities such as Hyderabad, Ahmedabad, Kochi, Jaipur, Patna, and Pune are planning to develop metro rail system in the near future (MoUD, 2013) to strengthen their urban transportation systems. The successful implementation of the metro in highly populated Indian cities could be a great solution considering the limitation of road infrastructure and high travel demand.

The success of metro does not rely solely on the design of network, location of station, frequency of service, fare, etc., but also on 'transfer facilities' in and around metro stations as metro rail does not provide 'door-to-door' facility. In this context, 'transfer facilities' refer to the facilities provided inside and around metro stations such as 'level change', 'travel information', and 'pedestrian facilities' to facilitate metro commuters to get their easy access to feeder mode stops from the metro platform and vice versa. Several researchers have highlighted the need for incorporating 'transfer facilities' around multi-modal passenger stations (Cheung and Lam, 1998; Krygsman et al., 2004; Liao et al., 2013). The prominence of station area transfer facilities and their influences on commuters' travel behaviour have also been investigated by researchers (Alshalalfah and Shalaby, 2007; Dell'Olio et al., 2011; Givoni and Rietveld, 2007; Lai and Chen, 2011). The role of transfer facilities is given due importance in the 'Station Site and Access Planning Manual' developed by the Washington Metropolitan Area Transit Authority (WMATA, 2008). Recent guidelines published by the Transportation Research Board (TRB) for 'providing access to public transportation stations' also highlight the need for transfer facilities in the context of access area planning for public transportation stations (TRB, 2012). Unfortunately, the adequate emphasis has not been given on transfer facilities in and around metro stations in the Indian context. There are glaring deficiencies related to 'qualitative' attributes of transfer facilities. For example, adequate travel information inside and outside metro stations (such as directional information, feeder service, and route related information) are inadequate or missing in many metro stations. Pedestrian facilities are poor in several locations due to the absence of footpath (sidewalk) or encroachment of footpath by hawkers. At some locations, the crossing of the road is considered unsafe due to the absence of pedestrian-phase in a traffic signal or zebra-crossing. Also, no attempt has been made to understand the perception of metro commuters in terms of their willingness-to-pay (WTP) for improvement of transfer facilities in the context of emerging countries such as India. It is necessary to understand WTP values in order to quantify the likely benefits to metro commuters due to the improvement of transfer facilities and decide additional charges (or metro fare) in lieu of improvement, which is commensurate with the benefits. It may be mentioned that in Indian megacities, there is substantial heterogeneity in socioeconomic and trip characteristics of commuters which may influence commuters' WTP for improvement of transfer facilities. Therefore, it is also important to investigate the heterogeneity effects (if any) of various socioeconomic and trip characteristics on commuters' WTP for formulating improvement strategies giving due attention to the preference of commuters having different socioeconomic and trip characteristics.

In the present study, WTP of metro commuters is calculated with respect to some of the transfer facility attributes. A stated choice survey instrument was designed to collect responses from metro commuters and the data were analysed by developing a random parameter logit (RPL) model. The effects of socioeconomic and trip characteristics of metro commuters on the mean estimates of random parameter and WTP values are also investigated using RPL models with heterogeneity. The present study is demonstrated with reference to Kolkata metro city.

## 2. Study area

Kolkata is one of the most important metro cities in India having a population about 4.49 million as recorded in the Census of India 2011 (MHA, 2011). The percentage of the male population is close to 53 while the average monthly household income is about INR 25,000 for city dwellers. The Kolkata metro rail serves as one of the most efficient public transport modes for daily trip makers within the city. The existing North-South metro corridor has an operational length of 27.217 km and serves about 0.543 million commuters per day on weekdays (IRPCMST, 2012). The corridor includes 24 metro stations covering north, central to south regions of the city (IRPCMST, 2012). Out of these 24 stations, 15 are underground, 2 are at-grade and remaining 7 are of an elevated type.

## 3. Theoretical background

In travel behaviour research, econometric models such as multinomial logit (MNL), mixed logit (ML) or random parameter logit (RPL), nested logit (NL), and generalised multinomial logit (GMNL) have been used extensively by the researchers (Fiebig et al., 2010; Greene et al., 2006; Hensher and Rose, 2007; Hess, 2010; Iraguen and Ortúzar, 2004). As the present paper aims to capture the preference heterogeneity of metro commuters towards the improvement of transfer facilities based on their socioeconomic and trip characteristics, RPL model was used. The RPL model has widely been used by the researchers in the field of travel behaviour analysis (Cherchi and Ortúzar, 2006; Greene et al., 2006; Phanikumar and

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