Transport Policy 36 (2014) 46–52

Contents lists available at ScienceDirect

Transport Policy

journal homepage: www.elsevier.com/locate/tranpol

How are comfort and safety perceived by inland waterway transport passengers?

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ARTICLE INFO

Keywords:
Latent variables
Safety
Comfort
Discrete choice models
Inland waterways transport

ABSTRACT

The geographical conditions of Colombia limit connectivity among regions, making communication between different areas of the country difficult. Although Colombia has a major waterway system that could facilitate regional communication, much of the territory is functionally disjointed, which is why the government and private operators seek to promote inland waterway transport and improve their safety.

In the field of provision of waterway transport in inaccessible regions, this paper analyses the influence that perceptions of safety and comfort of the service have on the choice of river transport by passengers using hybrid choice models incorporating latent variables.

The results of the hybrid choice model indicate that older workers attach less importance to the hull condition and safety; in turn, comfort is more valued by young workers and by those users who have a higher educational level. Variables such as the hull condition and how the boat is operated have a significant effect on the user perception of safety. Similarly, the results suggest that expanding the space between seats and developing strategies to improve the behaviour of other users significantly increase the perceived comfort of the service provided.

1. Introduction

Colombia is comprised of three main topographical areas: the Andean mountain system, which is composed of three mountain ranges and different inter-Andean valleys, the low lands and isolated mountain ranges as the Sierra Nevada de Santa Marta and Macarena. This geographical situation limits the connectivity among regions, preventing communication among them (Roelofs, 2013). Although the country has a major river system that could facilitate regional communication, much of the territory is functionally disjointed, a condition that along with the low population density hinders connectivity, service delivery, infrastructure provision and competitiveness of economic activities. Colombia's government is aware of this situation and it has made some strategic guidelines that aim to enable the country by improving the existing highway network, expanding ways of development and promoting multimodal (air and river) transport (DNP, 2010).

The promotion of waterway freight would reduce the external costs of transport (Márquez and Cantillo, 2013) and develop mining and agro-industrial activities (Roelofs, 2013), whereas policies promoting waterway passenger transport would improve accessibility in regions where the river is the only available path between zones (Berrío and Cantillo, 2012).

In addition to the formulation of policies that seek to promote inland waterway transport, the Colombian government also aims to strengthen the security and safety in the environment of the river corridor, and the use of more efficient technologies in terms of emissions (DNP, 2010). Although comfort is not a priority for the national government, from the perspective of users, it is a relevant attribute that can be improved in the context of the provision of inland waterway passenger transport. In Colombia, as experimented in the EU countries, and specifically in Italy (Eboli and Mazzulla, 2012), there is lack of regulations and there is needed to arrange univocal procedures for service quality measurement, where safety has national legislation and control by the state.

Transport safety is concerned with the protection of life and goods through regulation, supervision and technology development of all forms of transportation. Previous research has found that, in a preliminary evaluation, passenger perception about quality of service is basically influenced by trip frequency. However, after being asked to evaluate all the attributes, other attributes such as safety become as important as frequency (de Oña et al., 2012).

In bus-based public transport services, the factors influencing customer satisfaction that might be common to other modes of

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http://dx.doi.org/10.1016/j.tranpol.2014.07.006
0967-070X/

transport are availability of shelter and benches at bus stops, cleanliness, overcrowding, information system, safety, personnel security, helpfulness of personnel, and physical condition of bus stops (Eboli and Mazzulla, 2007). Similar conclusions have been obtained from the analysis of passenger transport by rail (Geetika, 2010).

In the safety analysis relating to waterway transport, it has been concluded that the boat is a major factor, also finding that passenger boats like barges, tugs and tankers, are the vessels that produce the greatest consequences when an accident occurs; likewise, the risk in navigation increases significantly caused by external factors such as bad weather and waterway conditions (Zhang et al., 2013). Regarding the comfort of the waterway transport mode, some research proposals have been carried out exploring the improvement in the delivery and allocation of boats using simulations software, showing that using mathematical models may help to improve the system (Taylor et al., 2005; Xu et al., 2013).

Direct measuring of comfort and safety is not possible because they are unobservable attributes influenced by perceptions and beliefs of individuals. However, introducing such attributes in choice analysis may improve the explanation of behaviour by explicitly representing the effects of latent constructs. Some studies that have investigated transport policies without taking into account the perceptions of users have concluded that it is important to analyse their behaviour to improve policy management (Cherry and Adelakun, 2012). In this sense, the perceptions of different types of individuals with regard to policies about infrastructure (Wennberg et al., 2010) and the use of public transport services have been analysed, finding that safety has a significant effect on the use of transport services (Delbosc and Currie, 2012).

Perceptions of safety in modes of transport have been studied based on various techniques such as the principal component analysis and the ordinal logistic regression (Lawson et al., 2013). The study of the perceptions of comfort and overall service level has repeatedly used discrete choice models such as stochastic route choice models (Zhao, et al., 2013; Eboli and Mazzulla, 2010), ordinal models (Kang, et al., 2013) and repeatedly mixed models with or without latent variables (Walker, 2001). Likewise, some stated preference techniques have been used to analyse the motivations of individuals to explore their policy implications in different contexts of choice (Caulfield et al., 2010).

In general, a choice process among transport alternatives (Ben-Akiva and Lerman, 1985) considers directly measurable attributes such as cost and time, but it can also assess perceptions of attributes that are not directly observable such as safety and comfort (Elrod, 1988), which in some cases are partly explained by the random component of the utility function through unobservable individual specific attributes (Walker, 2001). Recently, models have been explored that simultaneously consider a standard discrete choice model with latent variables (Daziano, 2012), seeking to improve the representation of the choice process by specifying variables representing user perceptions (Karash et al., 2008, Cao and Mokhtarian, 2005, Heat and Gifford, 2006, Duarte et al., 2009), such as safety and comfort.

In the field of provision of waterway transport in remote regions of Colombia, this paper studies by using a hybrid model of choice and latent variables, the attributes that have significant effects on perceptions of safety and comfort in choosing a waterway transport service for passengers. This research looks specifically at the provision of waterway transport in MINEROS SA, a Colombian company dedicated to the exploitation of the most important alluvial deposit of the country, using the Nechí river as the only transport alternative to access the production units and mobilising more than 1000 passengers daily, travelling on routes that have an average length of 33.8 km. This research had its origin in the results of satisfaction surveys that were applied preliminarily and allowed to show the dissatisfaction of users regarding the conditions of provision of waterway transport, especially about safety and comfort.

After this introduction, the rest of the paper is organised as follows. The next section describes the data. Then we describe the modelling framework. Later, the relevant results of the modelling process are addressed and discussed. Finally, we show the practical conclusions and implications of our work.

2. Data

The methodological approach used involved designing and implementing surveys for estimating models including latent variables in order to study the effect that perceptions about safety and comfort have on users' behaviour while using waterway transport. Specifically, we use data from a stated preference survey applied to workers of a company engaged in gold mining using the river as the sole transport mode.

2.1. Context

MINEROS S.A. is a Colombian company dedicated to the exploitation of the most important gold deposit in Colombia, located in the Nechí river, in the north-west of the country. The company provides a transport service for passengers using waterway transport, mainly for its employees. The system operates 24 h a day, 365 days a year. The shuttle service is operated by a group of harbour captains, a coordinator and several boaters.

The company transports more than 1000 passengers a day through the river, with an average distance between the main port and the production units of 33.8 km. Most of the vehicles used to transport staff are small boats with a maximum capacity of 22 passengers. During the time in which the study was conducted, the rainfall was high and no problems with navigation were detected; however, it is foreseeable that in times of low water level the travel times on the river are increased due to the inaccessibility of certain channels that are available in winter.

The time spent by workers commuting is part of their work day and in the case that this time exceeds the statutory working hours, the company pays overtime for the employees. This is a particularly important situation because by doing this part of the paid working hours, the time spent on transport can be perceived differently than usual. It also highlights the fact that the company provides transportation services to their workers for free.

Satisfaction surveys applied prior to this study pointed out the dissatisfaction of users regarding the conditions of waterway transport provision, especially on safety and comfort. In response, and before the problem adversely affects the company production, this study was performed to determine the perception of users about the level of service.

We applied a survey comprised of three bodies. First we asked for the individual users characteristics, such as age, gender, seniority and level of education. Then the individuals rated 10 indicators of safety and convenience of the service. Finally we applied the stated preference survey.

2.2. Indicators of safety and comfort

In addition to the socioeconomic characteristics of the respondents, the perception of users regarding the attributes of comfort and safety were recorded (see Fig. 1).

Initially we considered that indicators such as: hull condition and safety conditions were manifesting the latent variable safety. Likewise, we believed that the latent variable comfort could