



Understanding captive user behavior in the competition between BRT and motorcycle taxis



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ABSTRACT

Transit-dependent users, far from being captives, may have other transportation alternatives. In some developing countries, depending on the characteristics of the city, instead of cycling or walking, captive users opt for informal services to commute. Although they are less safe and possibly less comfortable than regulated BRT services, demand for informal services such as motorcycle taxis has grown in recent years, affecting the self-sustainability of some BRT systems. This research aims to provide a richer explanation of the choice process between the BRT feeder service and motorcycle taxis in the context of the City of Bucaramanga, Colombia. Initially, we analyzed a set of effect indicators by diverging stacked bar charts, and then we used a hybrid discrete choice model to incorporate comfort and safety perceptions, in addition to the tangible attributes traditionally used. We found that safety perception, which varies by gender, age and income, is a key variable in modeling the choice process. Based on an empirical chart analysis and the modeling results, we proposed some policies aimed at changing user choices to stimulate the demand for BRT feeder system.

1. Introduction

Traditional knowledge often divides transit users into two categories: choice and captive users. Choice users, which are also described as discretionary users (Giuliano, 2005), are people with cars; meanwhile, captive users, transit dependent (Polzin et al., 2000) or disadvantaged users (Litman, 2015), are lower-income people who must use transit because they do not own cars. However, far from being captives, people without cars are susceptible to the quality of service (Jacques et al., 2013), which makes some users opt for other alternatives. In some developing countries, especially in those cases in which quality of service offered to captive users is not always a priority for the service providers, some bus rapid transit (BRT) systems have lost ground to informal transportation services (Hidalgo and Díaz, 2014). In other cases, informal transportation systems may be more attractive to users because they offer low costs, high speed and, in many cases, door-to-door services.

Improving informal services (Rahman et al., 2016), integrating them with the BRT (Salazar et al., 2013), or rationalizing them (Chavis and Daganzo, 2013) may be valid options depending on the context of analysis. However, it is becoming increasingly difficult to ignore that the demand for informal transportation services has grown in recent years,

and today it is not just a transportation issue, but it has become a social problem (Cervero and Golub, 2007). There is increasing concern that many cities in developing countries have to deal with problems of financial self-sustainability of their BRT systems. One of the causes is competition from informal transportation services such as motorcycle taxis, which are relevant options in some developing African, Latin American, and Asian countries, such as the Philippines (Guillen et al., 2013). For instance, motorcycle taxis, which typically carry only one passenger, has become an essential part of the transportation sector in an increasing number of Sub-Saharan African cities (Díaz et al., 2015). It is also the case in some major Colombian cities (Jiménez et al., 2015), where this informal service is illegal.

In comparison with BRT, informal services are certainly less safe, as appears from the high prevalence of traffic accidents involving motorcycle-taxi drivers (Barbosa et al., 2014; Sumner et al., 2014), and possibly, less comfortable. The BRT systems have resulted in positive impacts due to reductions in operational costs, travel time and traffic fatalities (Wirasinghe et al., 2013; Nikitas and Karlsson, 2015), as well as reductions in air pollutant emissions, particularly for the introduction of cleaner technologies (Galván et al., 2016). Nevertheless, some captive users avail themselves of informal services as can be seen in the

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metropolitan area of Bucaramanga, Colombia, where the motorcycle taxi service carries about 15% of total demand (Metrolínea, 2017), which amounts to 40,000 captive users.

Informal transportation services are problematic to rationalize from a public policy standpoint because they provide significant benefits, particularly for poor people in terms of mobility, being that the reason why authorities simply give up doing anything about them (Cervero and Golub, 2007). However, it is important for authorities to address this issue, because informal transportation services contribute to congestion, and can produce disproportionate competition between public transit providers, especially in cities with high unemployment. Informal transportation may also contribute to elevated accident rates. For instance, in Bucaramanga, Colombia, the accident rates are correspondingly 1.17 and 3.68 times higher than the national rates of death and injury (Vargas, 2015). Therefore, it is necessary to address the problem.

Some authors point to as a need to analyze how transit service factors relate to mode captivity and mode choice (Beimborn et al., 2003; Krizek and El-Geneidy, 2007). These works highlight the importance of accessibility and connectivity on captivity and describe how specific transit service characteristics may play out in influencing demand, which is the first step toward ensuring more targeted and equitable policy responses (Jacques et al., 2013). However, far too little attention has been paid to the competition between BRT and motorcycle taxis in developing countries, where captive users should be the focus of consideration.

Several authors have studied the use of motorcycle taxis. In Akure, Nigeria, for example, Fasakin (2001) showed that motorcycle taxis are very popular among users because of non-availability of mass transit vehicles. In the same vein, de Vasconcellos (2005, 2013) suggested that quality problems of public transportation lead to an increase in the use of motorcycle taxis in Brazilian cities, while traffic deaths associated with motorcycles increased exponentially. Cervero and Golub (2007) showed how despite their illegality, motorcycle taxis are also popular in many Asian cities, including Jakarta and Bangkok. Kumar (2011) suggested that the collapse of contracted bus services led to the growth in motorcycle taxis in the in the capital cities of Douala (Cameroon), Lagos (Nigeria), and Kampala (Uganda). Likewise, Guézéré (2015) showed how motorcycle taxis came to dominate three secondary towns in Togo since appearing in the early 1990s. Finally, from the perspective of policies to address the phenomena, Diaz Olvera et al. (2012) concluded that public authorities must increase regulation of all transport modes.

This paper aims to investigate the attributes influencing the choice process between BRT feeder system and motorcycle taxis, popularly called *mototaxis* in some Latin-American countries, including Colombia, to recommend appropriate policies aimed at changing captive user options. In addition to the traditional observable attributes such as access time, travel time and fare, this research studies comfort and safety perceptions of riding a motorcycle taxi and a BRT feeder service. Specifically, this research studies the city of Bucaramanga, Colombia. The model only considers captive users, which can provide a better representation of transit choice, since it only applies to those who have a choice rather than to the entire population. To the best of our knowledge, this is the first study to incorporate alternative-specific latent attributes to investigate the choice process between BRT feeder service and motorcycle taxis.

The organization of the paper is as follows: After the present introduction, section 2 describes the context of the study, section 3 explains the methods and data, and section 4 shows the model specification. Section 5 summarizes the results and section 6 provides a discussion of them. Section 7 reveals policy implications, and, finally, section 8 summarizes the significant findings from the study and concludes the paper.

2. Context

Bucaramanga is the capital city of the department (province) of Santander, Colombia. The metropolitan area of Bucaramanga has the fifth largest economy by gross domestic product in Colombia and has the

fifth largest population in the country with about 1.3 million inhabitants. The city is located on a plateau in the Cordillera Oriental of the Colombian Andes, and many inhabitants occupy unstable lands descending steeply from it. Bucaramanga features a tropical monsoon climate and, on average, the temperatures are always high. In contrast with Bogotá, which is a predominantly flat and bike-friendly city, Bucaramanga is a city where cycling seldom used, because of its topographic characteristics, as well as its hot weather. Nevertheless, there are government and civil society efforts to increase levels of cycling in the city (Traffic Direction of Bucaramanga, 2016). Table 1 shows the main characteristics of Bogota vis-à-vis the metropolitan area of Bucaramanga.

The BRT system of the city, called *Metrolínea* locally, started operation in 2009. Its first phase, which consisted of six lines, opened with only a few stations (Jiménez et al., 2015). Along the BRT feeder system, there are several stops without access control (Fig. 1). At such stops, users can choose between feeder buses and motorcycle taxis, especially when the feeder service is slow to arrive. Besides, the feeder lines to a main BRT trunk network circulate on infrastructures where the congestion produces a greater effect on buses than on motorcycles. More information about *Metrolínea* may be obtained from its official website, www.metrolinea.gov.co.

According to the local transportation authorities, the main problems facing the BRT system have to do with low-quality service and, consequently, demand reduction. In fact, the current situation indicates that the system serves less than 50% of the expected transportation demand (Administration of Bucaramanga Metropolitan Area, 2011). During 2016, the BRT system carried 34 million and a half passengers (Metrolínea, 2017), which represented an average of 191,282 passengers per day, that is to say, 23% of the daily demand. Although this service is illegal in the whole country, motorcycle taxis mobilize 15% of total demand (Metrolínea, 2017), almost 125,000 trips a day, which is about 40,000 captive users.

In 2014, the BRT service fare was 1750 COP (about 0.875 dollars) while the motorcycle taxi fare was 2000 COP on average (approximately 1 dollar). In contrast to the BRT service fare that is flat and paid by card, the motorcycle taxi fare is negotiable and paid in cash. In the same year, Bucaramanga exhibited a rate of 10.05 deaths in traffic accidents per 100,000 inhabitants meanwhile the injury rate was 315.10 (Vargas, 2015). When classifying accidents by mode of transportation, motorcycle riders were in first place with 44.28% of deaths and 50.62% of injuries. Transit users were located well below with 11.38% of deaths and 2.43% of injuries (Vargas, 2015); clearly, the real risk of accidents for motorcycle users was considerably higher.

3. Methods and data

With the aim of studying the main factors affecting the choice process between BRT feeder service and motorcycle taxis, we reviewed relevant documentation (Administration of Bucaramanga Metropolitan Area, 2011) and interviewed public transportation users, including motorcycle taxis users, in eight stops without access control near local universities.

Table 1
Features of Bucaramanga vis-à-vis Bogota.

Feature	Bogota	Bucaramanga
Region	Andean Region	Andean Region
Department	Capital District	Santander
Population	8'080,734	1'322,950
GDP per capita (USD)	17,500	14,292
Elevation (m)	2.640	959
Average temperature (°C)	14.5	23
Average slope (%)	2	2 to 7
BRT system	<i>Transmilenio</i>	<i>Metrolínea</i>
Length of trunk network (km)	113	50
Length of feeder bus network (km)	663	70
Number of stations	147	139
Average headway (min)	7	8

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