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Determinants of ground transport modal choice in long-distance trips in Spain

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ABSTRACT

In transport economics, modeling modal choice is a fundamental key for policy makers trying to improve the sustainability of transportation systems. However, existing empirical literature has focused on short-distance travel within urban systems. This paper contributes to the limited number of investigations on mode choice in medium- and long-distance travel. The main objective of this research is to study the impacts of socio-demographic and economic variables, land-use features and trip attributes on long-distance travel mode choice. Using data from 2007 Spanish National Mobility Survey we apply a multilevel multinomial logit model that accounts for the potential problem of spatial heterogeneity in order to explain long-distance travel mode choice. This approach permits us to compute how the probability of choosing among private car, bus and train varies depending on the traveler spatial location at regional level. Results indicate that travelers characteristics, trip features, cost of usage of transport modes and geographical variables have significant impacts on long-distance mode choice.

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1. Introduction

Long-distance travel has rapidly increased in recent decades. Technological innovation, car ownership and economic growth are the major factors behind the rising demand for inter-city mobility. Improvements in highway, train and airport infrastructure have reduced travel costs and times while increasing safety. Schafer (1998) noted that travel time budgets have remained relatively constant, thus allowing people to travel further. Economic growth has also led to higher average disposable income; this favorable economic environment, along with less expensive car ownership, has contributed to the increase in long-distance business and personal trips.

Increased mobility implies economic, social and environmental consequences. According to Limtanakool et al. (2006), it permits a higher integration among regions, provides better accessibility to public services and social networks and extends the potential market for tourism activities. However, it can also have a negative environment effect, as longer trips involve increased energy consumption and greater emissions of pollutants. Furthermore, the investments required for enhancing long distance travel are substantial, implying high opportunity costs to the economy. In this sense, a deeper understanding of travel behavior in long-distance travel may ease transport policy challenges such as making mobility more sustainable and reducing negative externalities (Bhat, 1998). The demand for transportation services is the result of interactions between

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short- and long-term individual decisions. *Long term* travel planning typically involves making decisions concerning car ownership and residential or work locations. The final outcome of these decisions impact trip behavior, affecting short-term aspects such as modal choice, departure time and choice of route (Ben-Akiva and Bierlaire, 1999). To date, transportation and geographic researchers have typically studied the impact of these factors on daily and short-distance trips. Nonetheless, factors determining daily travel decisions and their interdependencies may have different impacts on less frequent events such as medium- and long-distance trips (Limtanakool et al., 2006).

This paper contributes to the overall discourse by increasing the knowledge in the determinants of modal choice in medium- and long-distance trips in Spain. More specifically, our primary goal is determining the influence of socioeconomic, land use and trip attributes on the selection of principal modes of transport among three possible choices: private car, bus and train. For this purpose, we use a database obtained from a survey carried out by the Statistical Office of Ministry of Public Works on the mobility patterns of Spanish residents. The data has a hierarchical structure, with travelers nested in their provinces of origin. This feature of the data permits us to incorporate unobservable variables through the application of multilevel analysis, which also enriches the existence knowledge in long-distance trips. In particular, we estimate a multilevel multinomial logit model with random intercepts to study the determinants of mode choice. Multilevel modeling techniques have been applied to commuting before but, as far as we are aware, this study is its first application to long-distance travel.

In line with previous research, our findings indicate that long distance modal choices are influenced by a combination of traveler socioeconomic characteristics, trip attributes and geographical factors. A key result is that the geographical context where the traveler begins the trip affects the alternative mode of transportation utilities in different ways. In addition, our analysis provides evidence of the positive effect of trip duration, measured as overnight stays, on railway demand; this has not been previously documented.

We initially review the existing literature on long-distance travel behavior, with an emphasis on modal choice studies. In Section 3, we explain the database and present some descriptive results of the included variables. In Section 4, we explain the foundations of rational choice relying on random utility theory in a multilevel framework. Section 5 displays the results of the estimated microeconometric models. Finally, Section 6 contains a summary of the major results and conclusions.

2. Previous research

Modal choice is the result of a complex process that includes objective and subjective determinants stemming from different disciplines and interrelated to a greater or lesser extent. In a recent survey, modal choice was defined as "the decision process to choose between different transport alternatives, which is determined by a combination of individual socio-demographic factors and spatial characteristics, and influenced by socio-psychological factors" (De Witte et al., 2013). In another survey, Buehler (2011) compared transport mode choice determinants in the case of Germany and the USA. Although both surveys were comprehensive examinations of the literature, they did not clearly distinguish between short- and long-distance studies.

Long-distance or inter-city trips are usually differentiated from short trips through the use of a distance threshold. Although there is no standard definition, trips are usually defined as long distance if they are longer than a threshold between 50 and 100 km (Axhausen et al., 2003; Kuhnimhof et al., 2009; Dargay and Clark, 2012).[3] Long distance trips involve more time and out-of-pocket cost, so the traveler facing the modal choice decision is in a different situation than an individual making a short-distance trip. In addition, modal availability and travel purposes are also different. While the principal motive of short-distance travel is commuting, long distance transit is dominated by pleasure and business pursuits. Therefore, long-distance trips are less frequent, making travelers less familiar with available transportation alternatives. Decisions on mode choice can be affected by similar variables in short and long-distance trips, but the impact of the same variables can be conditional to the distance travelled. The purpose of this literature review is not to find these differences but to focus our attention on the determinants typically found in long-distance travel studies.

Sociodemographic factors play a significant role in transport mode decisions. Bhat (1997) applied an endogenous segmentation model to the estimation of inter-city travel mode choices in the Toronto-Montreal Corridor. The author found that women were more responsive than men to rail frequency improvements in Canadian inter-city travel. Limtanakool et al. (2006) estimated binary logit models that distinguished between private cars and trains, finding that women were more likely than men to use trains. Georggi and Pendyala (2001) and Mallett (1999) also found that women were slightly less car dependent in long-distance trips. The effect of the travelers age on modal choice was not as clear. Limtanakool et al. (2006) indicated that senior commuters were more likely to use private cars than middle aged and young travelers. In an analysis of elderly and low-income mobility, Georggi and Pendyala (2001) found that the elderly were more bus dependent. Kuhnimhof et al. (2012) found a decrease in car mode share by german travelers aged 18–29. As for the impact of education on modal choice, only Limtanakool et al. (2006) included it as an explanatory variable for long-distance models. They found that highly educated commuters tended to use public transportation more often. It is important to note that age, education and occupation are related to income and car ownership. High income travelers have higher opportunity costs and values of time, which implies the selection of faster transportation modes such as airplanes because they are more sensitive to travel

[3] In other cases the long-distance travel is defined as those trips longer than 150 km (Schippl et al., 2008).

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