LIBERALIZATION OF THE INTERURBAN COACH MARKET IN GERMANY – AN ATTITUDINAL PROBLEM?

Francisco J. Bahamonde-Birke*
Energy, Transportation and Environment Department
Deutsches Institut für Wirtschaftsforschung – Berlin
and
Technische Universität Berlin
e-mail: bahamondebirke@gmail.com

Uwe Kunert, Heike Link
Energy, Transportation and Environment Department
Deutsches Institut für Wirtschaftsforschung – Berlin
e-mails: ukunert@diw.de; hlink@diw.de

Juan de Dios Ortúzar
Department of Transport Engineering and Logistics
Pontificia Universidad Católica de Chile
e-mail: jos@ing.puc.cl

ABSTRACT

In January 2013 the interurban passenger transport market in Germany was liberalized and several coach carriers emerged offering an alternative to the Deutsche Bahn AG, a state owned rail monopoly that has controlled the market for over 80 years. The coach carriers have attempted to position themselves not only at lower prices but also through product differentiation, for example marketing their services as the most ecological way to travel. Hence, it is important to consider attitudes and perceptions when analyzing this market.

One year after the liberalization we conducted a stated-choice experiment among students and employees of the Technical University of Berlin, where participants had to choose between different interurban public transport alternatives (regional and high-speed trains, and interurban coaches). Additionally, the experiment gathered perception and attitudinal indicators used to construct latent variables. Our results show that attitudes and perceptions indeed affect the way in which individuals choose between different transport modes and therefore they must be taken into account when analyzing the interurban passenger market in Germany.

Keywords: Liberalization, Coach Market, Latent Variables, Hybrid Discrete Choice Modelling, Attitudes and Perceptions
1. INTRODUCTION

To protect the railway industry and to promote network development, the interurban passenger transport market in Germany was controlled by a state rail monopoly (now Deutsche Bahn AG) for over 80 years and scheduled long distance coach services were practically forbidden (Maertens, 2012). Since 2013, the market has been liberalized and several coach carriers have emerged offering various scheduled routes connecting the major metropolitan regions (Gertsen et al., 2013).

Up to date, the market for coach services is still expanding and it appears that the interurban transport market has not yet reached a steady state. Early analyses of the development of service supply show that in the first year after deregulation, the number of lines (city to city connections) doubled and the number of tours offered more than tripled (IGES/bdo, 2013). As the statistical basis to monitor market development is not yet consolidated, it can only be estimated that the total demand for scheduled bus service has also about tripled in 2013 (ITP et al., 2014).

An interesting aspect of the new services is that the coach carriers have not only attempted to position themselves in the market at lower prices but also through product differentiation. For example, coach services have been marketed as the most ecological way to travel, offering also the possibility of compensating for CO2 emissions. In the same vein, several carriers provide Internet-services on board, some offer free snacks or the possibility of making pauses during a long trip, and some companies conduct satisfaction surveys after each trip. The German railways, in turn, can still count on offering a more reliable and safer service (INFRAS, 2007). As a consequence, the choice situation is no longer only affected by objective characteristic of the alternatives, such as fares or travel times, but also by the attitudes and perceptions of the individuals towards the alternatives (van Acker et al., 2011; Alvarez-Daziano and Bolduc, 2013).

2. THEORETICAL BACKGROUND

Under the assumption that individuals are rational decision makers it can be postulated that individuals $q$ facing a set of available alternatives $A(q)$, will choose the alternative $i$ that maximizes their perceived utility. In accordance with Random Utility Theory (Thurstone, 1927; McFadden, 1974) it is possible to depict this utility as the sum of a representative
component \( (V_{iq}) \) and an error term \( (\varepsilon_{iq}) \), which leads to the following expression (Ortúzar and Willumsen, 2011):

\[
U_{iq} = V_{iq} + \varepsilon_{iq}
\]  

(2.1)

The representative utility \( (V_{iq}) \), considering all attributes that can be quantified by an observer, is usually characterized through concrete and measurable properties of the alternatives and the individuals; the error term, in turn, is considered to take into account all unknown or abstract elements affecting the decision.

When considering a Hybrid Discrete Choice (HDC) modelling framework (Ben-Akiva et al., 2002), the modeler attempts to depict abstract attributes as measurable variables, in order to consider them as part of the systematic utility. Hereby, immaterial constructs, known as latent variables \( (\eta_{liq}) \), are also included into the modelling. These variables are supposed to represent attitudes and/or perceptions of the individuals and, as they cannot be directly observed, they must be constructed as a function of positively observed variables. The usual approach to construct these latent variables relies on a Multiple Indicators Multiple Causes (MIMIC) structure (Zellner, 1970; Bollen, 1989). Here, the latent variables are explained by a set of characteristics of the individuals and the alternatives \( (s_{iq}) \), through so called \textit{structural equations}, while explaining, at the same time, a set of attitudinal and/or perception indicators \( (y_{ziq}) \), previously gathered from the individuals, through so called \textit{measurement equations}. This framework can be represented through the following equations:

\[
\eta_{liq} = \sum_r \alpha_{lri} \cdot s_{riq} + \nu_{liq}
\]  

(2.2)

\[
y_{ziq} = \sum_l \gamma_{lzi} \cdot \eta_{liq} + \zeta_{ziq}
\]  

(2.3)

where the indices \( i, q, r, l \) and \( z \) refer to alternatives, individuals, exogenous variables, latent variables and indicators, respectively. The error terms \( \nu_{liq} \) and \( \zeta_{ziq} \) can follow any distribution, but they are typically considered to be Normal distributed with mean zero and a certain covariance matrix. Finally, \( \alpha_{lri} \) and \( \gamma_{lzi} \) are parameters to be jointly estimated.
If we assume a linear specification in $V_{iq}$, the utility function can be expressed as (2.4). This specification can be understood as a first-order Taylor expansion of any multi-variable complex function (and therefore it is always valid in the neighborhood of the estimation point); further, if the attributes are also assumed to be linear, the estimated parameters $\theta_{ik}$ and $\beta_{il}$ (related to the tangible attributes and latent variables, respectively) can be directly interpreted as marginal utilities:

$$U_{iq} = \sum_k \theta_{ki} \cdot X_{kiq} + \sum_l \beta_{li} \cdot \eta_{liq} + \varepsilon_{iq}$$ \hspace{1cm} (2.4)

Under the assumption that the error terms $\varepsilon_{iq}$ in (2.1) are independent and identically distributed Extreme Value Type 1 (EV1) with the same variance $\sigma^2$, the differences between the utilities associated with the alternatives follow a Logistic distribution with mean zero and scale factor $\lambda$, leading to the well-known Multinomial Logit (MNL) model (Domencich and Mc Fadden, 1975); in this case, the probability of choosing alternative $i$ is given by:

$$P_{iq} = \frac{e^{\lambda V_{iq}}}{\sum_j e^{\lambda V_{jq}}}$$ \hspace{1cm} (2.5)

and $\lambda$ is inversely related to the standard deviation of the error terms:

$$\lambda = \frac{\pi}{\sigma \sqrt{6}}$$ \hspace{1cm} (2.6)

However, as the scale factor cannot be estimated (assuming a linear function as usual) it is customary to normalize it to one (Walker, 2002).

The estimation of both parts of the model should be performed simultaneously, as a sequential estimation considering first the MIMIC part as an isolated system and evaluating then the expected values for the latent variables cannot guarantee consistent and unbiased estimators (Train et al., 1987; Ben-Akiva et al., 2002). However, empirical evidence sustains the thesis that the sequential estimation produces no major discrepancies.
regarding the ratios between the estimated parameters and, therefore, the marginal rates of substitution (Raveau et al., 2010; Bahamonde-Birke et al., 2010). Nevertheless Bahamonde-Birke and Ortúzar (2014a) proved that the estimators may indeed be affected by a significant deflation bias (affecting all estimated parameters) and Bahamonde-Birke and Ortúzar (2014b) proposed the following expression to correct this deflation:

$$\lambda_{HDC} = \sqrt{1 + \frac{6 \cdot \lambda_{DC} \cdot \sum_{l} \beta_{l} \sigma_{l}^{2}}{\pi^{2}}} \cdot \frac{\lambda_{DC}}{6 \cdot \lambda_{DC} \cdot \sum_{l} \beta_{l} \sigma_{l}^{2}}$$ (2.7)

where $\sum_{l} \beta_{l} \sigma_{l}^{2}$ stands for the variability induced into the model through the latent variables. This correction term performs in an acceptable manner as long as the ratio between the induced variability and the model’s own variability is sufficiently small. If that is not the case, the sequential estimation must be disregarded.

3. EXPERIMENTAL DESIGN

We conducted a stated choice experiment (Ortúzar and Willumsen, 2011) among students and employees of the Technical University of Berlin (TU-Berlin). The experiment was carried out one year after the liberalization and respondents were asked to choose between different interurban public transport alternatives (regional¹ and high-speed trains, and interurban coaches). Choosing Berlin for carrying out the study was not a coincidence, as this was the only major city in Germany for which (as a relic of the divided city) some coach routes were allowed before the liberalization (although still not representing an important market share; BMVBS, 2013); furthermore, Berlin is one of three German cities with a well-equipped interurban bus station (the others being Hamburg and Munich; Maertens, 2012). Thus, it was expected that the population would be more familiar with the services provided by the interurban carriers one year after the implementation.

The experiment was conducted online in January 2014. Altogether around 28,000 students and 2,500 employees were contacted. After data cleaning, the survey yielded a total of

¹ Regional trains must not be confused with commuter rail. Regional trains operate over long interurban distances, stopping more and over shorter distances than the high-speed trains. It is possible to travel across the country using only regional trains.
1,425 answers (1,170 from university students). The questionnaire had four parts. In the first, respondents were asked to describe the main characteristics (fare, travel time, number of transfers, etc.) of their last trips with the regional and high-speed trains of the Deutsche Bahn AG. At the end of this module participants were required, based on their experiences traveling with Deutsche Bahn AG (considering the same kind of trains and the same number of transfers), to state their level of agreement with the following statements:

- I was able to relax during the trip ($y_{11}$)
- I felt secure from thefts and losses ($y_{12}$)
- Traveling with heavy luggage was (would have been) uncomplicated ($y_{13}$)
- The departure time was reliable ($y_{14}$)
- The arrival time was reliable ($y_{15}$)
- It was possible to use the travel time productively ($y_{16}$)
- The station was easily accessible ($y_{17}$)
- Purchasing the ticket was uncomplicated ($y_{18}$)

In the same line, respondents were also asked to state their level of agreement with these statements under the assumption that a bus carrier with no transfers would offer the service. The level of agreement was stated on a scale which ranged from strongly disagree (1) to strongly agree (10).

The second part of the survey gathered travel behavior data as well as indicators related to the travelers’ attitudes towards current political issues discussed in Germany. Hereby, the respondents had to state the level of agreement with the following sentences:

- I agree with the nuclear power phase-out ($y_{21}$)
- Environment protection is more important than economic growth ($y_{22}$)
- I am willing to pay a 25% surcharge on my electric bill to reduce CO$_2$ emissions from coal power plants ($y_{23}$)
- Highway tolls should be introduced to compensate CO$_2$ emissions ($y_{24}$)
- Automobiles with higher engine power should pay more taxes ($y_{25}$)
- Investing on the development of high-speed trains should be encouraged ($y_{26}$)
- New highways or additional lanes to the existing ones should be built ($y_{27}$)
- New high-speed rail lines should be built ($y_{28}$)
- I agree with the introduction of speed limits on highways ($y_{29}$)
The third part of the questionnaire was the stated-choice experiment itself. Here, respondents were required to choose between a first pivotal alternative, representing the trip previously described, and a new travel alternative. Altogether, respondents were confronted with 12 choice situations, where the first six used a pivotal alternative based on the trip with the regional trains of the Deutsche Bahn AG and the last six considered a trip by high-speed train as the base situation. The alternatives were described in terms of their travel time, fare, number of transfers, mode of transport - regional trains (RE), high-speed trains (FVZ) and coaches (LB) - and safety level (represented through the number of severally injured passengers and the number of fatalities in the overall network over a year).

The attribute levels of the alternatives presented to respondents were optimized maximizing the D-efficiency of the experimental design as proposed by Rose et al. (2008). As it was not possible to personalize the attribute levels during the survey, they were fixed a priori based on the average levels of the attributes. These average levels, as well as the priors used for computing the D-error, were established in accordance with models previously estimated, based on the answers gathered during the pre-test of the survey (48 individuals). Finally the fourth part of questionnaire was intended to gather socioeconomic information about the respondents.

4. MODEL ESTIMATION

4.1 Model Structure

Before starting with the estimation of HDC models, it was necessary to establish the structure of the MIMIC-model considered. For this, the collected indicators were analyzed using factor analysis to guarantee a correct specification of the latent variables (LV). This way, it was possible to identify three components explaining 68.5% of the variance of the perceptions indicators ($y_{11}$ to $y_{18}$). In the same way, it was possible to establish that two variables captured 53.7% of the variability associated with the attitudinal indicators ($y_{21}$ to $y_{29}$). Table 1 presents the rotated component matrices for both types of indicators. On the basis of these results, we constructed five latent variables, as highlighted in Table 1. The first was identified as “Comfort”, as it was exclusively related to comfort indicators. The second component was called “Stress-free”, as it was associated with situations causing tension during the trip. Finally, the third component was identified as “Reliability”.

The third part of the questionnaire was the stated-choice experiment itself. Here, respondents were required to choose between a first pivotal alternative, representing the trip previously described, and a new travel alternative. Altogether, respondents were confronted with 12 choice situations, where the first six used a pivotal alternative based on the trip with the regional trains of the Deutsche Bahn AG and the last six considered a trip by high-speed train as the base situation. The alternatives were described in terms of their travel time, fare, number of transfers, mode of transport - regional trains (RE), high-speed trains (FVZ) and coaches (LB) - and safety level (represented through the number of severally injured passengers and the number of fatalities in the overall network over a year).

The attribute levels of the alternatives presented to respondents were optimized maximizing the D-efficiency of the experimental design as proposed by Rose et al. (2008). As it was not possible to personalize the attribute levels during the survey, they were fixed a priori based on the average levels of the attributes. These average levels, as well as the priors used for computing the D-error, were established in accordance with models previously estimated, based on the answers gathered during the pre-test of the survey (48 individuals). Finally the fourth part of questionnaire was intended to gather socioeconomic information about the respondents.

4. MODEL ESTIMATION

4.1 Model Structure

Before starting with the estimation of HDC models, it was necessary to establish the structure of the MIMIC-model considered. For this, the collected indicators were analyzed using factor analysis to guarantee a correct specification of the latent variables (LV). This way, it was possible to identify three components explaining 68.5% of the variance of the perceptions indicators ($y_{11}$ to $y_{18}$). In the same way, it was possible to establish that two variables captured 53.7% of the variability associated with the attitudinal indicators ($y_{21}$ to $y_{29}$). Table 1 presents the rotated component matrices for both types of indicators. On the basis of these results, we constructed five latent variables, as highlighted in Table 1. The first was identified as “Comfort”, as it was exclusively related to comfort indicators. The second component was called “Stress-free”, as it was associated with situations causing tension during the trip. Finally, the third component was identified as “Reliability”.

The attribute levels of the alternatives presented to respondents were optimized maximizing the D-efficiency of the experimental design as proposed by Rose et al. (2008). As it was not possible to personalize the attribute levels during the survey, they were fixed a priori based on the average levels of the attributes. These average levels, as well as the priors used for computing the D-error, were established in accordance with models previously estimated, based on the answers gathered during the pre-test of the survey (48 individuals). Finally the fourth part of questionnaire was intended to gather socioeconomic information about the respondents.
Regarding the attitudinal indicators, the first component is associated with a “Green” attitude, including a negative predisposition towards automobiles ($y_{24}, y_{25}, y_{27}$ and $y_{29}$). The second component is related to individuals, who have great appreciation to development of trains and rail lanes; for that reason, this LV was called “TrainFreak”.

### 4.2 MIMIC models

Given the complex structure of the data bank it was not possible to perform a simultaneous estimation of the HDC model, as for certain individuals (who did not provide information related to their perceptions) it was necessary to impute the latent variable values based on the estimated MIMIC model. In addition, individuals were faced with more than one choice situation making it imperative to rely on panel data estimation. Therefore, a sequential estimation was attempted and it was possible to establish that the bias caused by this second-best estimation technique was manageable. So, the MIMIC model was estimated first and the latent variables considered in the discrete choice model (DCM) component were built in accordance with these estimates.

It was necessary to estimate two different MIMIC models. First, one for the attitudes, which considered only characteristics of the individuals as explanatory variables. Figure 1 presents the final structure of the selected model (several specifications were considered).
In this case, “University” and “High School” are associated with working individuals holding the respective educational degree (in contrast to the base case representing university students). “Parental Home” only applies to students and it indicates that the individual still lives at the paternal home. “BahnCard” suggests that the individual holds a yearly discount card of the Deutsche Bahn AG (which are very common in Germany due to the price discrimination policies adopted by the state rail monopoly) and “Car” indicates ownership of an automobile. The remaining variables are self-explanatory. Table 2 presents the estimated parameters.

As can be expected, individuals more concerned about the ecology tend to support initiatives as environmental taxes or a nuclear phase-out, while, at the same time, they disapprove policies encouraging the use of the car, such as the absence of highway tolls or speed-limits. Also, people favoring public over private transport, represented through BahnCard or car ownership respectively, evidence a more positive attitude towards the natural environment. Working people are more concerned about the ecology than students and older people care more about the environment. The last results may be surprising but we have to take into consideration than we are working with students and young people of a technical university, which may have a different attitude towards the ecology than their congeneres. Finally, women care more about the environment than men.
Table 2 – Estimated Parameters for the Attitudinal MIMIC model

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Estimate</th>
<th>t-test</th>
<th>Attitudinal Indicator</th>
<th>Estimate</th>
<th>t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>University</td>
<td>0.222</td>
<td>2.741</td>
<td>Green Attitude</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HighSchool</td>
<td>0.323</td>
<td>2.084</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ParentalHome</td>
<td>-0.183</td>
<td>-2.691</td>
<td>NuclearPhaseOut</td>
<td>1.457</td>
<td>39.378</td>
</tr>
<tr>
<td>MiddleAge</td>
<td>0.254</td>
<td>4.536</td>
<td>Environment</td>
<td>1.221</td>
<td>35.912</td>
</tr>
<tr>
<td>Old</td>
<td>0.582</td>
<td>2.328</td>
<td>ElectricSurcharge</td>
<td>1.672</td>
<td>41.800</td>
</tr>
<tr>
<td>Woman</td>
<td>0.332</td>
<td>5.825</td>
<td>HighwayTolls</td>
<td>2.147</td>
<td>44.729</td>
</tr>
<tr>
<td>BahnCard</td>
<td>0.306</td>
<td>5.186</td>
<td>CarTax</td>
<td>1.653</td>
<td>41.325</td>
</tr>
<tr>
<td>Car</td>
<td>-0.547</td>
<td>-8.967</td>
<td>Highways</td>
<td>-1.047</td>
<td>-32.719</td>
</tr>
<tr>
<td>MiddleIncome</td>
<td>0.099</td>
<td>1.737</td>
<td>SpeedLimits</td>
<td>2.256</td>
<td>46.041</td>
</tr>
<tr>
<td>HighIncome</td>
<td>0.166</td>
<td>1.711</td>
<td>TrainFreak</td>
<td>2.116</td>
<td>44.083</td>
</tr>
<tr>
<td>Old</td>
<td>0.427</td>
<td>1.655</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Woman</td>
<td>-0.3</td>
<td>-5.172</td>
<td>HSTrains</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BahnCard</td>
<td>0.346</td>
<td>5.672</td>
<td>RailLines</td>
<td>2.097</td>
<td>43.688</td>
</tr>
<tr>
<td>Car</td>
<td>-0.107</td>
<td>-1.726</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MiddleIncome</td>
<td>0.099</td>
<td>1.737</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HighIncome</td>
<td>0.166</td>
<td>1.711</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Regarding the “TrainFreak” variable, it appears that both older people and high-income individuals favor rail transport. This result is in line with our expectations as, given the history of public transport in Germany, older people are not familiar with other alternatives, while high-income individuals are willing to allocate larger state resources to improve the faster ground transportation mode over alternative uses. Individuals holding a BahnCard have a more favorable attitude towards rail transport than individuals driving a car; finally, men have a more positive attitude towards rail transport than women.

As stated above, a MIMIC model was also estimated for the perception indicators. In this case, not only the characteristics of the individuals but also the attributes of the transport modes were considered as explanatory variables. It is also important to consider interactions between these two kinds of variables, as the attributes of the alternatives are perceived differently by different population groups (i.e. systematic taste variations, Ortúzar and Willumsen, 2011). The structure of the estimated model is shown in Figure 2.

---

2 As the signs of the estimators were known a priori, a one-tailed test was performed (α5% = 1.645).
Figure 2 – Structure of the Perception MIMIC model

Here, “Losses” and “Accidents” indicate that in the past the individual had suffered losses during a trip or been involved in a train accident, respectively. The number of transfers is represented through a discrete variable ranging between zero and four, while “BusUser” indicates whether the individual had undertaken at least one trip with coach services during the last three years. The estimation results are presented in Table 3.

In line with our hypotheses, all explanatory variables affecting perceptions are directly related with the specific alternatives for which they were calculated, whether considering the attributes directly or through systematic taste variations (it is important to note that not considering the latter works as well, but provides a worse goodness-of-fit).
In general terms, older and richer people have a worse perception of the coach services and a better one of the high-speed train. As previously stated, these valuations may be explained by firmly established prejudices towards a newer alternative as well as by an

\[\text{As the signs of the estimators were known } a \ priori, \text{ a one-tailed test was performed (} \alpha_{5\%} = 1.645).\]
overestimation of the alternative with which the individuals are accustomed to use. In the same line, coach service users exhibit a better valuation of their characteristics. It is noteworthy that holders of BahnCards are only biased towards high-speed trains, suggesting that these individuals do not necessarily favor also the regional trains.

As can be expected, having been involved in an accident or having experienced a loss on the trains affects negatively their perception; also, a trip with more transfers is perceived as less comfortable, stress-free and reliable. Regarding the transfers, it is important to note that women perceive them as a larger nuisance than men. The coach services are considered as the least comfortable and reliable way of travelling but, at the same time, they are considered less stressing than trains. High-speed trains are perceived as more comfortable and stress-free than regional trains (which was expected, as the former have more modern and comfortable wagons), but they are considered just as reliable.

**4.3 Discrete Choice**

This section reports the results of the estimation of the discrete choice component of the model. Besides the previously described latent variables, socioeconomic characteristics of the individuals and attributes of the alternatives (price, travel time, number of transfers, transport mode and safety level) were considered. In addition, an inertia variable taking the value of one when individuals chose their revealed preference option in spite of the advantages of new alternatives was introduced. Altogether, there were 9,712 observations from 1,073 individuals (not every individual took part in the discrete choice experiment) available for estimation and the correlation (panel effect) between the responses of a given individual was taken into account.

The estimation was performed sequentially using BIOGEME (Bierlaire, 2003), so it was necessary to perform a correction of the estimates accounting for the bias described by Bahamonde-Birke and Ortúzar (2014b). It was possible to establish that the average ratio between the variability induced through the latent variables and the model’s own variability was nearly 30%. Thus, we calculated that the ratio between the recovered estimates and the real parameters was around 90%. Table 4 presents the corrected parameters for the estimated model.
Table 4 – Estimated Parameters for the Discrete Choice model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimated Value</th>
<th>Standard Deviation</th>
<th>t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inertia</td>
<td>0.371</td>
<td>0.0358</td>
<td>10.373</td>
</tr>
<tr>
<td>LB</td>
<td>-1.377</td>
<td>0.243</td>
<td>-5.662</td>
</tr>
<tr>
<td>RE</td>
<td>-0.333</td>
<td>0.100</td>
<td>-3.341</td>
</tr>
<tr>
<td>Travel Time</td>
<td>-0.0178</td>
<td>0.000844</td>
<td>-21.053</td>
</tr>
<tr>
<td>Travel Time * LV Green</td>
<td>0.00264</td>
<td>0.00139</td>
<td>1.904</td>
</tr>
<tr>
<td>Ln(Price) * Very Low Income</td>
<td>-5.819</td>
<td>0.209</td>
<td>-27.872</td>
</tr>
<tr>
<td>Ln(Price) * Low Income</td>
<td>-5.453</td>
<td>0.234</td>
<td>-23.270</td>
</tr>
<tr>
<td>Ln(Price) * Middle Income</td>
<td>-4.842</td>
<td>0.385</td>
<td>-12.565</td>
</tr>
<tr>
<td>Ln(Price) * High Income</td>
<td>-2.743</td>
<td>0.534</td>
<td>-5.135</td>
</tr>
<tr>
<td>Safety Level</td>
<td>-0.00298</td>
<td>0.00109</td>
<td>-2.743</td>
</tr>
<tr>
<td>Transfers</td>
<td>-0.438</td>
<td>0.033</td>
<td>-13.221</td>
</tr>
<tr>
<td>LV Comfort</td>
<td>0.224</td>
<td>0.123</td>
<td>1.820</td>
</tr>
<tr>
<td>FVZ * LV TrainFreak</td>
<td>0.937</td>
<td>0.164</td>
<td>5.703</td>
</tr>
</tbody>
</table>

Analyzing this table, it can be seen that the signs of all parameters are in accordance with the theory. This way, the travel time, the number of transfers and the possibility of being involved in an accident affect negatively the utility of an alternative. The inertia value reveals a tendency of the individuals to stick to their former choices. The negative effect of price is greater for individuals with lower income, and decreases as income increases. It is important to mention that price is perceived logarithmically (the linearity of price and travel time was tested with help of a Box-Cox transformation), meaning that equal changes have larger importance when the price is lower.

Regarding the latent variables, it is noteworthy that two of them (“Reliability” and “Stressfree”) do not evidence a statistically significant effect over the utility function. A possible explanation is that individuals internalize these two effects as a part of the intrinsic characteristics of the alternatives and, therefore, they are accounted for by the modal parameter; in fact, when modelling without modal parameters these variables get statistically significant, but the adjustment worsens. As it was expected, the perception of the remaining latent variable, “Comfort”, affects positively the utility of the alternative.

Both attitudinal latent variables are statistically significant but affect the utility ascribed to the alternatives in a different manner. The “Green” attitude interacts with travel time in a fashion that resembles a systematic taste variation. Thus, ecologically oriented individuals

---

4 As the signs of the estimators were known a priori, a one-tailed test was performed (α5% = 1.645).
appear more willing to accept a longer travel time than the rest of the population. This finding is in line with the perception that shorter travel times imply higher speeds and, therefore, more CO₂ emissions and a larger damage to the environment. Interestingly, “Green” individuals have no positive predisposition towards coach services whatsoever, despite their marketing campaign seeking to position the mode as an ecological alternative. Finally, as expected, “TrainFreaks” tend to favor the high-speed trains, but there is no evidence to sustain that they prefer regional trains to coaches.

5. CONCLUSIONS

Our analysis reveals that, in accordance with our expectations, attitudes and perceptions affect the way in which people choose their transport modes in the case of intercity travel. Therefore these aspects must be taken into consideration when analyzing the expanding coach market in Germany. As a consequence of that, the marketing campaign of the coach services (aiming for product differentiation) can be considered adequate, as some of these aspects play an important role in the choice of mode. Nevertheless, they have not been successful in positioning the coaches as an environmental-friendlier alternative.

The coach services face a population that, in general terms, is not familiar with this new alternative and is reluctant to change their habits. In this line, young people represent an interesting market opportunity for coach services, as they are more open to try this new alternative and not as negatively predisposed against coaches as the older population. Another aspect that must be taken into account is that the flexibility of smaller coaches allows offering connections with no need of transferring, which have been revealed as a negative feature affecting both the subjective perception of comfort, reliability and ease of travelling, and the direct utility ascribed to the alternatives.

One important finding of this study is that individuals with higher ecological concern are not affected to the same extent by larger travel times as the rest of the population. This can be related to the fact that faster transport modes are normally more polluting, and therefore eco-friendly individuals are prepared to travel longer in order to reduce the environmental damage.

It was not possible to establish an undeniable link between the perceptions of reliability and stress-free travelling associated with a certain alternative and its utility, and it is
possible that these perceptions are being captured by the general characterization of each transport mode. Further research is needed to confirm this hypothesis. On the contrary, it was indeed possible to describe a social group of train enthusiasts that are willing to favor the railways in spite of the apparent advantages of other alternatives. However, this favoritism is not extended to regional trains. Finally, it was possible to establish that fares are perceived logarithmically by the population, and that equal changes are not perceived similarly depending on the base price.

ACKNOWLEDGMENTS

We gratefully acknowledge the support of Becas Chile given by the Chilean Council for Scientific and Technological Research (CONICYT), the Millennium Institute in Complex Engineering Systems (ICM: P05-004F; FONDECYT: FB016), the All Latitudes and Cultures BRT Centre of Excellence funded by the Volvo Research and Educational Foundations, the Alexander von Humboldt Foundation and the Centre for Sustainable Urban Development, CEDEUS (Conicyt/Fondap/15110020).

REFERENCES


