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INTEGRATING TRAVELERS' HETEROGENEITY IN SUBSCRIPTION CHOICE PROCESSES THROUGH HYBRID CHOICE MODELLING: AN APPLICATION TO THE SWISS RAILWAY MARKET

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ABSTRACT

Public transportation companies often classify customers into only two classes, i.e. first and second class. This segmentation largely ignores travelers' needs and may leave heterogeneity within classes. Using a discrete choice experiment, this work investigates if the introduction of dedicated sections based on travelers' characteristics can provide them additional value.

Keywords: public transportation, segmentation, heterogeneity, hybrid choice, Swiss

Introduction

The needs of Swiss travelers are becoming increasingly diverse and nuanced (Nguyen & Mariani, 2014). This provides an opportunity for public transport companies, that could potentially increase revenues by offering more targeted and differentiated offers to their customers. Innovations could vary the type of services offered and the breadth and depth of the product line, aiming at meeting the diverse needs of travelers. Nowadays, the current product line of the main Swiss railway company is primarily organized around key service offerings, such as the Half-Fare or General Abonnement travel cards. The increasingly crowded trains (Ungricht, 2010) and the accompanied increasing heterogeneity of traveler types and behaviors on the trains (Saameli, 2014) forced the railway company to introduce differentiated products. Currently, dedicated sections are present on the train, such as silence, business, and family (dedicated to specific individual needs). Although these sections provide additional value to the specific individuals, they are not priced separately. Even though pricing these sections separately has not been planned in the nearest future, gaining quantitative insights into the degree to which travelers value these sections could be of high interest to the Swiss railway company and to their Marketing managers. Consequently, our work investigates through a discrete choice experiment whether it could be valuable to potentially extend the actual service by explicitly offering access to different sections on the train, potentially against payment. Given the nature of public transportation, consumers are forced to social contacts (i.e. individuals do not travel alone). Especially during rush hour, travelers often need to stay physically close to one another in crowded trains. Travelers are heterogeneous and differ on a multitude of dimensions, such as their behaviors on the train, their needs or their trip purposes. For some travelers, this diversity itself may create value. For others, it may

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create disutility, as they feel restricted or at unease (i.e. due to other people that show different behaviors compared to theirs). These individuals may prefer dedicated sections on the train that allow them to travel with similar individuals and stay separate from the ones with different travelling needs. We capture this general tendency using the latent construct of out-group derogation, i.e., individuals' tendency to ascribe more negative characteristics to individuals that are not part of their own social group (Dasgupta, 2004) and test if it influences travelers' preferences for dedicated sections. We hypothesize that a higher (vs. lower) tendency towards out-group derogation leads to a higher utility for a travel card with access to dedicated sections (i.e., section for travelers with certain needs) compared to common ones (i.e., where diverse types of travelers travel together). Furthermore, we examine how demographic characteristics drive the preference towards the different sections through the latent construct.

Methodology

Survey Design

The study of traveler's behavior is not trivial as several different attributes can influence the decision. Work environment, infrastructure (i.e. number of trains, number of wagons per train, pick hour), trip purpose, and even socioeconomics are attributes commonly considered. However, perceptions and attitudes could be also very important in the decision-making process. In this study, we decided to include only demographics variables and a latent variable (i.e., out-group derogation) in order to be able to more accurately represent the real behavior of travelers. With the help of a Swiss market research agency, we recruited 506 travelers in the German-speaking part of Switzerland to fill in our survey. Only individuals that were planning to purchase a public transport subscription in Switzerland (or renew their current one within the next year) and who were paying for their subscription by themselves, were eligible to participate in our 20-minutes survey. Our sample was stratified by age to represent the Swiss-German population of train travelers (Swiss Federal Statistical Office, 2014). The survey was structured as follows. First, participants were introduced to the general procedure of the survey. Second, they were asked a set of questions related to their travel behavior and their travel preferences. Third, they were asked to complete a choice experiment. Fourth, they had to complete questions related to the latent variable. Finally, they had to fill out a section related to their demographic characteristics. The entire survey was conducted in German. Before the actual choice experiment, travelers familiarized with the concept of a travel card. In the choice experiment, each travel card provided access to public transportation in Switzerland for one year. Travelers were then asked to imagine that they were about to purchase a new travel card online and that in the following 12 pages they would face 12 different purchase situations (i.e., choice tasks) in which the website would offer them a different set of travel cards from which they could choose. They were also informed that in each purchase situation, they would have four purchase options. That is, they could either choose one of the three displayed travel card options or leave the store without purchasing a travel card by clicking "None".

Choice Design

In order to maximize the richness of the data without creating a complex and elaborated choice experiment, we developed a blocked choice design. The design consists of five blocks with 12 choice tasks per each block to ensure an equal distribution of attribute

levels within each attribute. Respondents were randomly assigned to one of the five blocks. In each block, the order of the choice tasks was randomized. In each task, we included three product alternatives and a non-choice option. Each alternative had four attributes: "train section access", "geographical access", "travel during rush hour (i.e. 7:00 – 8:00 and 17:00 – 18:00)", and "price". The "train section access" attribute describes sections on the train to which each traveler has access through a travel card. This attribute had two levels: "common section only" and "common section + dedicated section". "Common section only" defines access to the common sections of the train. These sections are accessible by any traveler holding a valid ticket. "Common section + dedicated section" defines instead access to dedicated sections of the train (in addition to access to the common ones). The type of people present in the different sections provides the substantial difference between the two categories of access. Travelers with "common section only" cannot access the dedicated sections, whereas travelers with "common section + dedicated section" have complete access to all train sections. Additionally, alternatives with "common section + dedicated section" level of the attribute "train section access" have an attribute specifying the type of the dedicated section. This attribute had four levels: "business", "silence", "family", and "lifestyle". These sections differ from each other in order to better satisfy the needs and habits of the travelers. For simplicity, we will refer to the "common + dedicated section" as simply "dedicated section" from now on throughout the paper. The "geographical access" attribute describes the geographical extension in which the subscription is valid. It had three levels: "area small (zone)" identifies access to an area large as two zones; "area medium (region, canton)" identifies access to an area large as an entire region/canton; "area big (country)" represents access to public transport throughout Switzerland. The "rush hour access (7:00 – 8:00 and 17:00 – 18:00)" attribute describes the subscription validity during rush hours and it had two levels: "no (outside rush hour only)" identifies a subscription only valid outside the rush hour and does not permit the traveler to take the train with that subscription during rush hour; "yes (no time restrictions)" identifies a subscription with no time restrictions that could be used also during rush hour. The "price" attribute describes the economic outlay to purchase a specific travel card. It had four levels ("CHF 1'500.-", "CHF 3'000.-", "CHF 4'500.-", and "CHF 6'000.-").

Out-group derogation

We began developing the scale to measure the tendency towards out-group derogation based on an existing scale that measures the tendency towards in-group favoritism in different social groups (Lewis and Bates, 2010). This scale uses three items related to the strength of identification with the group, the preference for affiliating with in-group members, and the importance placed on marrying within the group items, of which the first two are particularly relevant for us. Based on these two items, we extended the scale to additional social groups, such as economic groups, cultural groups, and status groups. We did that in order to be able to measure the concept in general terms and not only based on one single group dimension. Additionally, we generated new items to measure in-group favoritism, particularly in the train context, i.e., regarding traveling needs and behaviors, in order to account for the particular context of our research. Based on the discussions in several focus groups, we adjusted and validated all scale items. Finally, we conceptually reversed the items to render them consistent with the definition of out-group derogation. That is, instead of asking for a preference to be with similar people or a preference for an affiliation with similar people, we asked for a preference to distance oneself from different people or a preference not to affiliate with different people. The resulting scale has 12 items.

Model Specification

Different model formulations were tested to accommodate preference heterogeneity, latent variables, and capture the panel nature of the data (due to the number of responses available for each respondent). Traditional multinomial logit (MNL), mixed logit (ML) and integrated choice and latent variable – ICLV – models were estimated. Prior to the formulation of the ICLV models, a principal component analysis (Rencher & Christensen, 2012) was performed using all the available indicators of the out-group derogation, with the aim of verifying their consistency with the latent factor. Three (the fifth, seventh and ninth item) of the twelve indicators had either high or low values of uniqueness and for that reason they were removed. The path-diagram of the ICLV model is available upon request.

Results

In the below table (Table 1), we report the details of the estimated models.

--- *Table 1 about here* ---

Model 1 shows the coefficient estimates of the basic MNL model that included all attribute levels of the alternatives present in the choice experiment. Each coefficient represents the contribution that its specific attribute level has on the overall utility of the alternative. First, the results show that broader geographical access provides higher utility to travelers ($\beta_{\text{area small}}$ = -.94, $p < .01$; $\beta_{\text{area medium}}$= -.02, n.s.; $\beta_{\text{area big}}$ = reference level). Second, being allowed to travel during rush hours provides higher utility vs. not being allowed to do so ($\beta_{\text{rush hour}}$ = .99, $p < .01$). Third, higher prices provide a lower utility than lower prices, as shown by the price coefficient (β_{price} < -.01, $p < .01$). Lastly, having access to the dedicated section provides a lower utility than having access to the common section only ($\beta_{\text{common section only}}$ = -.18, n.s.; $\beta_{\text{dedicated section}}$ = -.59, $p < .01$), regardless of the type of the dedicated section (β_{business} = .08, n.s.; $\beta_{\text{life-style}}$ = -.03, n.s.; β_{silence} = .27, $p < .01$;

β_{family} = reference level). Model 2 and Model 3 are two Mixed Logit (ML) models that take into account the heterogeneity of the panel structure of the dataset (error component models, ML1 & ML2) and the geographical distribution of the sample (scale parameter associated with the permanent address, ML2). The results of these two models are quite similar to Model 1 (see Table 1). Finally, Model 4 shows the coefficient estimates of the ICVL model. In this model, we integrated the latent variable out-group derogation into the utility functions of Model 3. Here, having access to the dedicated section provides a higher utility than having access to the common section only. This holds to be true only if the type of dedicated section selected is the silence one ($\beta_{business}$ = .06, n.s.; $\beta_{life\text{-}style}$ = -.04, n.s.; $\beta_{silence}$ = .33, $p < .01$; β_{family} = reference level). In addition, the higher the value of out-group derogation, the higher is the utility of alternatives with dedicated section (compared to the alternatives with common section only) ($\beta_{out\text{-}group\ derogation\ x\ common\ section\ only}$ = .26, n.s.; $\beta_{out\text{-}group\ derogation\ x\ dedication\ section}$ = .40, $p < .05$). Further, regarding the structural model, an increase in the age leads to a decrease in out-group derogation ($\alpha_{young\ adults}$ = -2.37, $p < .01$; α_{adults} = -2.67, $p < .01$; $\alpha_{best\ agers}$ = -2.75, $p < .01$; $\alpha_{seniors}$ = -2.74, $p < .01$) whereas gender does not play any effect ($\alpha_{young\ adults}$ = .15, n.s.). Measurement model estimates of the ICVL model are available upon request.

Conclusions

In this work, we show that a higher (vs. lower) tendency towards out-group derogation of travelers leads to a higher utility for a travel card with access to dedicated sections compared to common sections. Our results indicate, that the average traveler has a significant preference for the dedicated section access (vs. common section only) only when the silence section is present in the subscription. This effect is amplified for travelers with a high tendency towards out-group derogation. By linking the demographic characteristics of the travelers to the out-group derogation, results show that older travelers are less inclined towards it (compared to younger travelers), while gender plays no role. These findings imply that separately pricing these dedicated sections may allow the generation of additional revenues (such as for the Swiss railway company). Additionally, given the fact that different sections are already available on the trains (silent, business, and family sections), this pricing practice can become operationally feasible and easy to implement from a marketing point of view. More research is certainly needed to arrive at a final decision about whether and how to provide targeted offerings related to dedicated section access. For instance, future research should better define the target segments and link them to the current customer segmentation of a given railway company, the actual price points should be specified in detail, and market simulations should be utilized to gauge the potential market share of such travel cards. Finally, future research should additionally measure perceptions of fairness of such offerings.

References

References available upon request.

APPENDIX

Parameter Description	β (SE)	β (SE)	β (SE)	β (SE)
	Model 1: MNL	**Model 2: ML1**	**Model 3: ML2**	**Model 4: ICVL**
Common Parameters				
Geographical access, area small (zone)	-.94 (.06) ** *	-(.08) ** 1.11 *	-(.12) ** 1.17 *	-(.11) ** 1.16 *
Geographical access, area medium (region, canton)	-.02 (.04)	-.04 (.05)	-.03 (.05)	-.03 (.05)
Rush hour access (7:00 – 8:00 and 17:00 – 18:00)	.99 (.09) ** *	1.11 (.10) ** *	1.18 (.14) ** *	1.17 (.14) ** *
Price	<-(<.01) ** 0 1) *	<-(<.01) ** 0 1) *	<-(<.01) ** 0 1) *	<-(<.01) ** 0 1) *
Alternative Parameters (Common Section Only)				
Common section only – alternative-specific constant	-.18 (.14)	-.20 (.18)	-.25 (.19)	.39 (.53)
Alternative Parameters (Dedicated Section)				
Dedicated section, alternative-specific constant	-.59 (.13) ** *	-.71 (.16) ** *	-.77 (.18) ** *	.23 (.53)
Dedicated section (business)	.08 (.06)	.07 (.06)	.07 (.07)	.06 (.07)
Dedicated section (life-style)	-.03 (.06)	-.05 (.07)	-.04 (.07)	-.04 (.07)
Dedicated section (silence)	.27 (.05) ** *	.32 (.07) ** *	.33 (.08) ** *	.33 (.07) ** *
Error Component Parameter				
Error component parameter (panel data)		-(.11) ** 2.07 *	-(.20) ** 2.18 *	-(.19) ** 2.14 *
Scale Parameters				
Scale effect, Lake Geneva region			2.58 (.51) ** *	2.81 (.62) ** *
Scale effect, Swiss Plateau			.89 (.11) ** *	.90 (.11) ** *
Scale effect, North-west Switzerland			.85 (.10) ** *	.86 (.10) ** *
Scale effect, Eastern Switzerland			.99 (.14) ** *	.99 (.14) ** *
Scale effect, Central Switzerland			1.19 (.16) ** *	1.21 (.16) ** *
Latent Variable				
Out-group derogation on common section only alternative				.26 (.19)

Out-group derogation on dedicated section alternative	.40 (.19**)
Structural Model (DV: out-group derogation)	
Age – Young Adults (16-25)	-(.41** 2.37) *
Age – Adults (26-49)	-(.43** 2.67) *
Age – Best Agers (50-64/50-63)	-(.45** 2.75) *
Age – Seniors (>64/>63)	-(.43** 2.74) *
Gender (Male)	.15 (.10)

Table 1. Estimated Models (MNL, ML1, ML2, ICVL)
Note: * Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.