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transportation mode : a bivariate model**

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Abstract

This paper investigates tourists' profile in relation to both intra-destination movement patterns and transportation mode choices at the destination through the use of bivariate probit models. The analysis is based on a field survey conducted among tourists visiting the Canton of Ticino, Switzerland. The results show a positive correlation between visiting more than one region and the use of private transportation at the destination. In particular, the two variables are explained by a mixed combination of independent variables; the transport mode choice of tourists can be well explained by demographics while destination movement patterns are rather influenced by trip characteristics. The introduction of activity participation and motivation increases consistently the fit of the model allowing a better understanding of tourist behaviour in relation to the spatial extent of the destination visited and to the transport mode selected. Finally, conclusions are drawn for policy implications in destination management and transport planning.

Keywords: *Intra-destination visits; Transportation mode; Tourist behaviour; Bivariate probit*

1. Introduction

The analysis of tourist movement patterns is widely investigated within the tourism literature (see for example, McKercher *et al.*, 2012). A particular interest has been given to modelling destination choice as well as exploring the spatial dimension of tourists' mobility within and/or between destinations. Further attention in the literature is oriented towards the determinants of intra-destination movement patterns, as well as of dispersion and multi-destination trips, as the three notions are deployed by tourists aiming to maximize their benefits by visiting more attractions during a trip. Additionally, an important aspect in understanding tourists' choice in terms of intra-destination movement is the analysis of push motivation defined as the internal factors related to travel behaviour.

Moreover, movement patterns are also likely to be affected by the transportation mode used during the visit. The transport mode selection of tourists at the destination is less widely investigated than the one between the origin and the destination, although the transport mode choice has important implications regarding the tourist consumption at the destination. In this context, a critical distinction in terms of transportation is between public and private modes, where the latter gives more flexibility in terms of time at disposal and itinerary choice.

The aim of this study is to investigate tourists' profile in relation to both visiting more than one region and transportation mode choices within a destination. In order to cope with the research objective we rely on two binary variables, where the first one discriminates between one or more regions visited while the second distinguishes between public and private modes of transport. After having verified that the two variables are correlated with each other, we estimate a bivariate probit model. In particular, the models proposed examine the relation between the two binary variables and a set of independent variables expressing demographics, trip characteristics, push motivation and activity participation.

The paper is organized as follows. In section 2 we provide an extensive literature on the different aspects concerning the application proposed. Description of the data and method used are then reported in section 3, whereas model results are presented in section 4. Finally, discussion and conclusion are provided in section 5.

2. Literature

Movement patterns of tourists are spatial changes in the location of their activity consumption. The phenomenon is analysed in the literature on a global level, where tourists move from their origin region to destination regions, and between destination regions at a local level that is from one activity to another (Leiper, 1979). On a local level, a further distinction is made between macro and micro levels or also called inter- and intra-destination movement patterns (Xia and Arrowsmith, 2005, Lau and McKercher, 2007, Dejbakhsh *et al.*, 2011). This distinction leads to the consideration of methodology choice and results implications. Regarding methodology applied for studying movement patterns, data collection is either technology supported; such as GPS (Global Positioning System) tracking (Hallo, *et al.*, 2012, McKercher *et al.*, 2012), camera-based systems, mobile phone tracking, PDA (Personal Digital Assistant) tracking, or is conducted by means of self-administered surveys, which are a sort of travel diaries often combined with maps. The advantage of data tracked by self-administered questionnaires and interviews is that additional non-spatial information can be also collected versus technology based methods (Xia and Arrowsmith,

2005, Dejbakhsh *et al.*, 2011). At micro level the data is mainly technology supported, while surveys and maps are generally used for collecting macro level data. Similarly, the analysis of the spatial data on micro level is often supported by a software of geographic information systems (GIS), which through digital mapping helps to visualize and interpret all forms of geographically referenced information (Freytag, 2002, O'connor, Zerger and Itami, 2005, Shoval and Issacson, 2006, Lau and McKercher, 2007, McKercher and Lau, 2008), whereas at macro level survey data is analysed by only using statistical software (Koo *et al.*, 2012).

Consequently, in terms of implications, applications for spatio-temporal movements at the micro level can emphasize on real-time and space tracking of tourist itineraries, in order to help local services and management, while the examination of macro level movements are usually aimed to characterize general travel patterns for tourism marketing initiatives or facility management (Xia and Arrowsmith, 2005). Moreover, Lew and McKercher (2006) suggest that analysing intra-destination movements can have impacts on transport planning, product development and impact management. The decision between the different levels, type of data collection and analysis depends on the scope of research, the size of the area researched and type of data available to be collected.

In the context of intra-destination movements Lew and McKercher (2006) define destination as a territory where tourism products and activities are accessible within a daytrip. Analysing the factors that can influence the movement patterns of tourists, Lau and McKercher (2007) grouped them into human factors (related to the tourist itself), physical factors (characterising the destination, such as destination configuration, transport network and attractions) and trip factors (specific to the travel, such as duration, type of travel). Among these factors, Lew and McKercher (2006) find travel behaviour to be the main intervening element in travel decision making at the destination level; indeed the individual characteristics of tourists are further investigated in the following section.

2.1 Individual characteristics of tourists in relation to movement patterns

Tourist movement patterns are motivated and concerned by the availability of attractions and activities at the destination (Burton (ed.), 1995). Regarding attractions, Xia *et al.*, (2011) implement Semi-Markov processes in order to model the time spent at different attractions and the distance among them, in order to further estimate the probability of the visitation of the attractions. Xia *et al.* (2010) propose a market segmentation based on the dominant movement patterns of tourists among attractions in terms of socio-demographic and travel behaviour variables. In terms of trip characteristics, the relationship between the length of stay and number of places visited is proved to be positive (Pearce, 1990; Oppermann, 1997), where longer stay implies broader visit of the destination. Moreover, tourist behaviour in terms of intra-destination mobility also depends on tourist personality, as introduced first by Plog (1974) and later developed by Debbage (1991), Fennell (1996) and Plog (2002). In particular, Plog (1974) identified two opposite personality typologies (also known as psychographics) namely, "allocentric", comprising tourists more inclined to explore and "psychocentric", comprising tourists less inclined to explore. Plog (2002) further enriches the literature identifying five categories of personality types and introducing the concept of Venturesomeness.

Debbage (1991) is applying Plog's model in the context of a Bahamian Resort. Factors such as length of stay, vehicle rental, origin of the tourist, and place of stay most effectively discriminate between the two types of spatial behaviour, in terms of only staying on the island or also discovering the places off the island. Similarly, Fennell (1996) analyses the

space-time budget in four regions of the Shetland Islands. Respondents were prior divided into special interest and general tourist activity-motivation groups. Tourists belonging to the special interest group move more extensively throughout the four regions than general tourists. Besides trip characteristics and travel behaviour, also cultural background is found to be influential by Dejbakhsh *et al.*, (2011) in their research on spatial behavioural patterns of international tourists travelling to Melbourne. Concerning familiarity with the destination, Lau and McKercher (2007) and McKercher *et al.*, (2012) note that among the independent travellers visiting Hong Kong first time visitors have more narrowed itineraries than repeaters. However, repeat visitors not always travel less extensively since there are also findings stating that repeaters go beyond the usual attraction locations due to their interest (Fennell, 1996). This phenomenon can be interpreted as destination specific and related to both the number and spatial distribution of attractions available and the regional characteristics. Iconic attractions are mainly visited the first time, while repeat visitors develop a specific interest at the destination and their extent of visit depends on the locations.

2.2 Mode of transport within destination

The transportation mode selected by tourists during their visit can have an influence on their movement patterns. Analysing the link between tourism and transport in literature, Prideaux (2000) notices that although long-haul transport in relation to tourism is well researched, the link at the destination level received lower attention, in spite of the vital role that transport planning and networks play in destination development. The basic transport modes considered for moving within the destinations are private means such as cars, both owned and rented, public transportation and, especially for tourist, organized commercial transportation. Limtanakool *et al.*, (2006) identify sets of variables that can influence the choice among modes of transport such as cost, socioeconomic characteristics of the tourist and spatial configuration of land use. They find that gender has no significant effect on mode choice for leisure trips, whereas the availability of transport services at the origin has a great impact. In this context self-drive tourism obtained the most attention in the literature, in fact car touring behaviour gives the most flexibility in time and itinerary choice (Taplin and Qiu, 1997), hence increases the degree of multideestination visitation (Tideswell and Faulkner, 1999). Dickinson and Robbins (2008) note that travelling by private car gives important contribution to tourism, particularly in rural areas, where attractions' visit often depends on private transportation mode. Eaton and Holding (1996) evaluate public transport alternatives to the private car in British National Parks. They conclude that the distribution of attractions, and the transport linkages connecting to service providers and to each other, can lead to a more effective planning of services for tourists and has marketing implications for both attractions and destinations. Regarding tourist behaviour, Taplin and McGinley (2000) have conducted a research on daily activity analysis of car tourists described through a multi-period linear programming. Further on, Hyde (2008) in investigating car travel for touring vacation finds positive correlation with age and negative with length of stay and the motivation of desired to be surprised. Hyde and Laesser (2009) distinguish among three types of holiday (stay-put, arranged and freewheeling touring) in respect to motivation and transport mode choice at the destination, among others.

2.3 Intra-destination movement patters and transport mode choice

The individual characteristics of tourists regarding movement patterns and transport mode choice have been also addressed in a more interrelated perspective. In particular, Lew and McKercher (2006) identify factors influencing intra-destination movement patterns of tourists

in relation to urban transportation planning and model itinerary patterns accordingly. Becken and Schiff (2011) use two-stage hurdle models to analyse the decision to use either car or air-travel in New Zealand through the average distance travelled. Among the findings, they note that repeaters travel for shorter distances per night and tourist characteristic variables such as length of stay, age, travel party relationship and purpose of travel have better explanatory power on mode choice and distance travelled.

Regarding dispersal, Wu and Carson (2008) consider it as a multiple destination travel and daily excursions as an important part of it. They acknowledge that higher dispersal relates to higher mobility and private transport mode use. According to Koo *et al.*, (2011), dispersal encapsulates the notion of visiting areas outside of the main gateways of a destination. Their article looks for determinants of the ratio and propensity of dispersal through a probit model. Dispersal is measured in terms of night stopovers as a binary variable whether they occur within or outside the main destinations analysed. Their findings reveal significant causal relation, among others, with transport mode choice and activity engagement. Previously, Koo *et al.*, (2010) apply discrete choice experiment in order to analyse transport mode choice and regional dispersal in terms of tourist travelling single or multi-destination. They find travel fares to be the main determinant of the choice among the transport modes.

In this vein, it is reasonable to expect that both the area visited by tourists and the means of transport used are influenced by motivations, in particular push motivations. Indeed, Lee *et al.*, (2002) acknowledge that pull motivations are related to destination choice, while push factors are determining activity pursuit at the destination. As intra-destination movements are related to activity pursuit, the extent of the area visited by tourist can be influenced by their internal forces which are pushing them to undertake a vacation, other than socio-demographic variables and trip characteristics. In this line the following application proposes a model jointly investigating the extent of the destination visited along with the selection of transport mode.

3. Data and method

The data refers to a field survey conducted in the Canton of Ticino, Switzerland within a broader study aimed at investigating activities undertaken at the destination. As Ticino is a summer destination, the survey was carried out during June, July and August 2010. In particular, tourists were randomly approached in nine main touristic points located around the entire Canton and asked to participate in the survey through face-to-face interviews. The survey locations were selected in accordance with the representative of the Tourism Office of Ticino. In total, 848 visitors were interviewed, resulting in 629 valid observations for the following application.

Among the aspects investigated within the survey, one was related to tourist mobility within the destination and another to mode of transport while staying at the destination. In particular, tourists' mobility was captured by asking them to list the places to be visited in the Canton during their entire holiday. Tourists were supported with a map of the destination in order to receive precise data. The answers have then been classified according to the four touristic regions of the destination, which are illustrated in Figure 1. The Canton of Ticino is a small geographical area (i.e., 100 kilometres south-north distance) any location of which is potentially accessible within the same day journey from any base point.

As for the transportation mode, the options available in the questionnaire covered all the possible means of transport available at the destination, including public and private transportation.

Figure 1. Touristic regions in the Canton of Ticino



Given the literature on psychographic typologies related to movement patterns and the geographical context of destination, the binary variables identifying tourists' movement patterns and transportation mode have been created as follows:

$$y_{i,DEST} = y_{i1} = \begin{cases} 1, & \text{if tourist } i \text{ visits more than one region} \\ 0, & \text{if tourist } i \text{ visits only one region} \end{cases} \quad (1)$$

where the regions at destination are four (as shown in Figure 1) and,

$$y_{i,TRA} = y_{i2} = \begin{cases} 1, & \text{if tourist } i \text{ uses private transport} \\ 0, & \text{if tourist } i \text{ uses public transport} \end{cases} \quad (2)$$

where private transport refers to owned car, rental car and motorbike (or any combination of the three) while public transport considers bus and train (or any combination of the two).

In order to investigate the interdependency of the two choices, namely the decision to visit one or more regions and the choice of the transportation mode, a bivariate probit model has been estimated. In particular, in a discrete choice context, the analysis of correlated decisions is commonly addressed by extending the probit model to the estimation of more than one equation, leading to bivariate or multivariate probit models¹. Applications of bivariate (and multivariate) probit models can be found in several fields of research. In particular, in the tourism sector there are only few applications. Eugenio-Martin and Campos-Soria (2010) attempt to identify the relationship between the climate in the region of residence and destination choice in tourism demand. Castillo-Manzano (2010) estimates a bivariate probit model in order to investigate the relationship between making a purchase at airport stores and

¹ Refer to multivariate probit models for model with more than two equations. See Greene (2003) for details on the estimation of both bivariate and multivariate probit models.

consuming food/beverages at the airport catering facilities. LaMondia and Bhat (2011) implement a multivariate binary probit model to understand the combination of leisure activities during holiday in the Northwest Territories of Canada.

In this context, the bivariate probit model involves the estimation of two equations and it is specified as follows:

$$\begin{aligned}
 y_{i1}^* &= \beta_1' \mathbf{x}_{i1} + \varepsilon_{i1}, \quad y_{i1} = 1 \text{ if } y_{i1}^* > 0, \quad 0 \text{ otherwise,} \\
 y_{i2}^* &= \beta_2' \mathbf{x}_{i2} + \varepsilon_{i2}, \quad y_{i2} = 1 \text{ if } y_{i2}^* > 0, \quad 0 \text{ otherwise,} \\
 [\varepsilon_{i1}, \varepsilon_{i2}] &\sim N_2(0, 0, 1, 1, \rho), \quad -1 < \rho < 1
 \end{aligned}
 \tag{3}$$

where y_{i1} and y_{i2} are binary variables representing individual observations and, in our case previously defined in Equations (1) and (2), x_{i1} and x_{i2} are sets of explanatory covariates, and ε_{i1} and ε_{i2} are the random parts (i.e., the unobserved parts) assumed to be jointly normally distributed with means zero, unit variances and correlation ρ .

As for the explanatory covariates, a set of variables included in the questionnaire has been used. In particular, the respondents were asked to evaluate 17 statements about push motivation and 13 activity participation at the destination along with questions about demographics and trip characteristics. Table 1 reports the descriptive statistics of the sample for the variables under investigation.

Table 1. Sample descriptive statistics for variables under investigation

Characteristics	Mean	Median	Std. dev.	Min	Max
Demographics					
Gender (Male)	0.39	-	0.49	0	1
Domestic	0.52	-	0.50	0	1
Age	3.45	4	1.46	1	7
Trip characteristics					
Repeat visitor	0.68	-	0.47	0	1
Commercial Accommodation	0.65	-	0.48	0	1
Holiday daily budget	60	47	81.5	0	1500
Number of nights	4.49	4	4.57	0	60
Motivation					
Being physically active	2.17	2	1.06	1	4
Rediscovering myself	1.94	2	0.99	1	4
Trying new food	2.50	3	1.03	1	4
Visiting historical places	2.68	3	1.06	1	4
Experiencing a simpler lifestyle	2.32	2	1.05	1	4
Feeling safe and secure	2.55	3	1.15	1	4
Experiencing landscape/nature	3.47	4	0.78	1	4
Meeting new people	2.27	2	1.06	1	4
Feeling at home	2.41	2	1.09	1	4
Activity participation					
Sports and renting equipment	1.18	1	0.54	1	4
Visiting museums and/or historical buildings	1.87	2	0.93	1	4
Boat trips	1.88	2	0.81	1	4
Destination visited (more than one region)					
	0.56	-	0.50	0	1
Transportation mode (private)					
	0.53	-	0.50	0	1

With the exception of number of nights and holiday budget, all the variables considered are categorical. In particular, for demographics, the age is subdivided into seven age groups (from under 20 years old to over 71 years old) and two dummy variables capture the domestic visitors (52% of the sample) and male travellers (39% of the sample). In terms of trip characteristics, binary variables discriminate between visitors staying at commercial accommodation (65% of the sample) and repeaters (68% of the sample). As for budget and length of stay, tourists interviewed report a daily average budget of 60 CHF (approximately, 62 USD) allocated to activities at the destination (excluding accommodation) and median length of stay of four nights. Four point scales have been applied for measuring statements on motivation that pushes tourists to visit the destination (not at all important, rather unimportant, rather important, very important) and on activity participation during the entire stay (never, once, few times, every day). Among the push motivation variables analysed, the statement that receives the least importance is “rediscovering myself”, whereas “experiencing landscape/nature” registers the highest importance. As for activity participation, at least 50% of the sample partakes of boat trips or visits museums and/or historical buildings.

The bottom part of Table 1 reports the descriptive statistics for the two binary variables identifying the intra-destination movement pattern and transportation mode. In particular, the 56% of the sample interviewed are visiting more than one region and the 53% are using private transport in their movement within the destination.

The estimation of the model expressed in Equation (3) with dependent variables indicated in Equations (1) and (2) can be derived from the following probabilities:

$$P(y_1, y_2 | x_1, x_2) = \Phi_2[q_{i1}\beta'_1x_{i1}, q_{i2}\beta'_2x_{i2}, q_{i1}q_{i2}\rho] \text{ where, } q_{im} = 2y_{im} - 1, m = 1, 2. \quad (4)$$

where, Φ_2 denotes the bivariate standard normal cumulative distribution function. The estimation of the coefficients relies then on the following log likelihood:

$$\log L = \sum_i \ln P(y_1, y_2 | x_1, x_2) \quad (5)$$

The model is estimated using the full information maximum likelihood. Total marginal effects are further derived and reported in the model results section.

4. Model results

Two bivariate probit models have been estimated for the choices of the number of regions to visit and transportation mode, respectively. In particular, the first model (M1) specifies the correlated choice in terms of demographics and trip characteristics. The second model (M2) further investigates the specification by introducing a set of variables identifying push motivation and activity participation.

The results of the two estimated models are presented in Table 2. Two columns are reported for each model where the first one (DEST) indicates the parameters associated with the choice of visiting more than one region whereas the second one (TRA) lists the coefficients associated with the choice of using private transport for intra-destination travels. For each model the correlation between the disturbances in the equations (RHO(1,2)) is also reported. Finally, the bottom part of the table shows the statistics for the model fits and the prediction properties of the two models. In particular, along with the log-likelihood at convergence we

also report the log-likelihood ratio test where for model M1 is calculated against the restricted model, estimated with only the constant terms (M_{constant}), whereas for model M2 the test is calculated against model M1. The Wald statistic for the test of the hypothesis that the correlation equals zero is also reported. In this context, we observe that the correlation is present and positive, suggesting that the more tourists are likely to opt for private transport the more they are likely to visit more than one region, and vice versa. This result confirms the appropriateness of the estimation of a bivariate model.

Table 2. Model results

	Model M1				Model M2			
	<i>Index equation for</i>				<i>Index equation for</i>			
	<i>DEST</i>		<i>TRA</i>		<i>DEST</i>		<i>TRA</i>	
	Coeff.	(t-ratio)	Coeff.	(t-ratio)	Coeff.	(t-ratio)	Coeff.	(t-ratio)
Constant	-0.8415	(-2.96)	-0.8208	(-2.89)	0.0526	(0.13)	0.6192	(1.92)
Demographics								
Gender (Male)	0.1861	(1.76)	0.3048	(2.88)	0.0476	(0.41)	0.2089	(1.88)
Domestic	0.1210	(1.05)	-0.4153	(-3.62)	0.1252	(1.00)	-0.4161	(-3.45)
Age	0.0472	(1.31)	0.1016	(2.87)	0.0380	(0.97)	0.0915	(2.27)
Trip characteristics								
Repeat visitor	0.1413	(1.17)	0.2184	(1.79)	0.2730	(2.04)	0.2780	(2.13)
Commercial accommodation	0.4504	(4.16)	-0.0332	(-0.30)	0.4550	(3.79)	0.0064	(0.06)
Daily budget	-0.0002	(-0.65)	-0.0002	(-0.66)	-0.0001	(-0.37)	-0.0003	(-1.01)
Number of nights	-0.0005	(-0.14)	0.0025	(0.25)	-0.0003	(-0.10)	0.0072	(0.62)
Motivation								
Being physically active	-	-	-	-	-0.0810	(-1.54)	-0.1041	(-1.92)
Rediscovering myself	-	-	-	-	-0.1237	(-2.13)	-	-
Trying new food	-	-	-	-	0.1523	(2.70)	-	-
Visiting historical places	-	-	-	-	0.2737	(4.40)	-	-
Experiencing a simpler lifestyle	-	-	-	-	0.1193	(1.82)	-	-
Feeling safe and secure	-	-	-	-	-0.2873	(-4.77)	-0.1387	(-2.56)
Experiencing landscape/nature	-	-	-	-	-0.3206	(-3.96)	-	-
Meeting new people	-	-	-	-	-	-	-0.1298	(-2.25)
Feeling at home	-	-	-	-	-	-	-0.1017	(-1.72)
Activity participation								
Sport	-	-	-	-	-0.0012	(-2.43)	-	-
Visiting museums	-	-	-	-	0.0009	(1.64)	0.0018	(2.76)
Boat trips	-	-	-	-	-	-	-0.0005	(-1.68)
	Coeff.		(t-ratio)		Coeff.		(t-ratio)	
RHO(1,2)	0.2676		(4.28)		0.1905		(2.75)	
Model Fits								
Observations	629				629			
Parameters	17				32			
Log-likelihood	-825.14				-752.76			
Log-likelihood ratio test	$(M_{\text{constant}}, M1)$ 63.51 (15;25)				$(M1, M2)$ 144.76 (15;25)			
Wald test (RHO(1,2))	18.34 (1;3.84)				7.57 (1;3.84)			
Predictions for DEST and TRA								
Neither DEST nor TRA	predicted correctly 124 of 629 observations				predicted correctly 83 of 629 observations			

Looking at the parameter estimates for demographics, we find that they are not statistically significant in explaining the choice of visiting more than one destination. Only the dummy variable associated with the gender appears to be slightly significant although only in model M1. Nevertheless, the parameters associated with the same demographic variables entered in the equation for the transportation mode choice are significantly different from zero, in both M1 and M2 models. In particular, male tourists and older visitors are more likely to use private transport means for travels within the destination independently from their movement patterns, whereas domestic tourists are more likely to use public transport during their stay at the destination.

Turning to coefficients associated with trip characteristics, we observe that neither daily budget nor number of overnight stays are significantly related to the two choices under investigation. However, from both M1 and M2 models, we find that staying at commercial accommodation has a positive impact on the likelihood of visiting more than one region. As a further finding, for model M2 we observe that being a repeat visitor has a positive impact on both the number of region visited and mode of transport used. In particular, we register that repeaters are more likely to use private transport and visit more than one region.

Focusing on the introduction of motivation and activity participation in the two equations, we observe that model M2 obtains an overall improvement in the goodness of fit confirmed by the log-likelihood ratio test. A further measure in favour of model M2 (against model M1) is provided by looking at the prediction properties of the two models. As indicated in the bottom part of Table 2, for model M2 we register an increase of 6% in the ability of either equation "DEST" or "TRA" to predict correctly the data observed. The correlation between the disturbances in the equations decreases as variables reflecting motivation and activity participation are inserted in the model although the correlation is still significantly different from zero as confirmed by the Wald test. Overall, seven and four motivations have been found to be significantly different from zero for the "DEST" and "TRA" equations, respectively. In particular, motivations like "being physically active"² and "feeling safe and secure" are present in both equations showing a common negative impact. As for activity participation, only two result are significant in each equation, although one of them being in common (i.e., "visiting museum") and with the same positive sign.

In order to better understand the impact and implications of motivation and activity participation included in model M2, total marginal effects have been derived and reported in Table 3, along with marginal effects for demographics and trip characteristics which appeared to be statistically significant in model M2. In particular, a one point increase in the motivation "being physically active" results in a decrease of 0.2% in the probability of visiting more than one region and in a decrease of 2% in the decision of travelling by private transport. Similarly, a one point increase in the importance of the statement "feeling safe and secure" reduces the likelihood to visit more than one region (using private transport) by 9.7% (3.3%). Other motivation variables with negative effects on the number of regions visited, namely "rediscovering myself" and "experiencing landscape/nature", decrease the probability to visit more than one region by 4.4% and 11.4% per one point increase in the associated importance. On the other hand, we register a significant and positive influence for statements like "trying new food", "visiting historical places" and "experiencing a simpler lifestyle" with an associated increase of the probability of visiting more than one region by 5.4%, 9.7% and

² Please note that, for the first equation, the motivation "being physically active" is significant only at an alpha level of 0.15.

4.2%, respectively. As for the impact of motivation variables on the transportation mode choice, we find that a significant and negative effect is associated with “meeting new people” and “feeling at home”. In this context, we note that all the four motivations found to be significant for the transportation mode equation express a negative impact as the importance of the motivation increases, although their impact do not exceed the threshold of four percentage point. A significant but considerably marginal impact has been registered for the activity participation. However, it is interesting to note the combined positive effect reported for the coefficient associated with the frequency of visiting museum, that is the more tourists tend to visit museums, the more they are likely to visit more than one region and travelling by private transport.

Table 3. Total marginal effects

	<i>Total marginal effects for</i>	
	<i>DEST</i>	<i>TRA</i>
	<i>(>1 region)</i>	<i>(private)</i>
<i>Demographics</i>		
Gender (Male)	-	0.0645
Domestic	-	-0.1285
Age	-	0.0283
<i>Trip characteristics</i>		
Repeat visitor	0.0878	0.0769
Commercial accommodation	0.1619	-
<i>Motivation</i>		
Being physically active	-0.0025	-0.0295
Rediscovering myself	-0.0440	-
Trying new food	0.0542	-
Visiting historical places	0.0974	-
Experiencing a simpler lifestyle	0.0424	-
Feeling safe and secure	-0.0975	-0.0334
Experiencing landscape/nature	-0.1141	-
Meeting new people	-	-0.0401
Feeling at home	-	-0.0314
<i>Activity participation</i>		
Sport	-0.0004	-
Visiting museums	0.0003	0.0005
Boat trips	-	-0.0002

Examining the marginal effect for demographics on the transportation mode equation, it is interesting to observe the consistent negative impact associated with domestic tourists who have a 12% higher probability to use public transport than foreign tourists. On the other hand, private transport has more probability to be selected by male tourists (6.4%) and by older tourists (2.8% per class considered in this study and mentioned in the data section).

Finally, looking at the marginal effect for trip characteristics we observe that, being a repeat visitor increases the probability of visiting more than one region and using private transport by 8.8% and 7.7%, respectively. Particularly interesting, staying at commercial accommodation increases the probability to visit more than one region by 16.2%.

5. Discussion and conclusion

This paper has investigated tourists' movement patterns and transport mode choice within a destination using bivariate probit models. The analysis has been based on a field survey conducted among tourists visiting the Canton of Ticino, Switzerland in the summer 2010. The models proposed attempt to examine the influencing factors of wider movement patterns and transport mode choice. In particular, two bivariate probit models have been estimated where the first one explains the correlated choices, of visiting one or more regions within the destination and using private or public transport, by demographic and trip characteristic variables, while the second model extends the first one by further introducing, as explanatory factors, motivation and activity participation. Furthermore, marginal effects for the second model have been derived in order to quantify the associated impacts in terms of probabilities and to direct the policy implications.

The results show a positive correlation between visiting more than one region and the private mode of transportation used at the destination. In fact, private transport users are more likely to visit more regions, as they are more flexible, can freely explore the regions without paying attention to timetables of public transport means and itinerary choice. Interestingly, we have found different factors explaining either the likelihood to visit more than one region or to use private transport. In this context, the transport mode choice of tourists can be well explained by demographic variables being influenced by age, gender and origin, the last in terms of whether the trip is domestic or international. Nevertheless, destination movement patterns are not as determined by demographic variables as transport mode choice; they are rather influenced by trip characteristics. Confirming the previous studies in the literature on movement patterns, familiarity with the destination can give prediction on the extent of the area visited. In the case of Ticino, the repeater tourists are more likely to visit a larger extent of the destination.

Based on our findings, the introduction of activity participation and, especially, motivation increases consistently the goodness of fit of the model by adding significant explanatory power to the understanding of tourist behaviour in relation to the spatial extent of the destination visited and to the transport mode selected. In this context, the results are related to the psychographic profiles of tourists. In particular, statements like "Rediscovering myself", "Feeling safe and secure" and "Experiencing landscape/nature" have a negative effect on visiting more than one region, which can be explained by psychocentric behaviour. On the contrary, the positive effect associated with motivations such as "Visiting historical places" and "Trying new food" on visiting more regions can be explained by allocentric or curious behaviour. As for activity participation we register low impacts either on intra-destination movement patterns or on transport choice. This result can be explained by the fact that most of the activities examined in the survey are available in all four regions. Only the statement "visiting museums" has a positive effect on the two dependent variables, suggesting that tourists interested in cultural attractions are travelling more extensively, reinforcing the results related to motivation and allocentric behaviour.

In terms of policy implications, the results presented in this study provide useful information for destination marketing and policy planning. First, our findings show that the main driver of tourists in visiting more than one region is cultural novelty seeking. Therefore, marketing campaigns of destination marketing organizations should concentrate on attracting more tourists with cultural interest, who will travel more throughout the destination. Furthermore, by increasing the number of cultural activities available at the destination eventually the

length of stay and the expenditure of tourists could be extended. Moreover, cultural activities should be more advertised internationally to capture novelty seeking tourists from outside Switzerland. The second implication reflects on the high marginal effects registered for domestic tourists using public transport at the destination independently from the number of regions visited. This preference can be explained by the existing subscriptions and offers for public transport in Switzerland, widely used among residents. In order to reduce the traffic problem, at the same time increasing the visitation of the destination, the destination marketing organization and transport/city managers should design appealing public transport promotion programs that can facilitate the connection between touristic attractions located within different regions of the destination. This could potentially lead domestic tourists to visit more than one region and international tourists to use public transport during their visit. Third, motivations in favor of public transport are related to safety and security, socializing and being physically active. In this context, in order to further incentivize the use of public transport, the destination marketing organization and public transport managers could direct promotional campaigns accordingly trying to emphasize these aspects. Fourth, combining the previous implications, tailor-made routes for cultural tourists, packaged together with appealing public transport promotions could lead to reduce the car usage and increase the visitation of the destination.

Further research in different destination contexts is suggested in order to support the findings highlighted in this study. Moreover, regarding the methodology of the data collection, additional GPS data could be integrated into similar analysis in order to have a more precise tracking of the movement patterns of tourists during the entire holiday. Finally, we encourage future research to jointly analyse the spatial dimension and transportation mode used by estimating different hierarchical structures for a better understanding of tourist behaviour at the destination.

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