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The role of temperature and other environmental factors on coastal destination choice. An application to Spanish domestic tourism.[1]

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Abstract. This paper investigates the impact of temperature and other environmental variables on destination choice decisions in a context of domestic coastal tourism in Spain. Destinations are characterized in terms of coastal 'attractors' such as beach characteristics and temperature as well as travel cost. By means of a discrete choice model based on random utility theory, these variables are used to explain the observed pattern of interprovincial domestic trips. The results show the trade-offs between temperature and attractiveness in terms of the probability of choosing a particular destination. These models are used to investigate the impact of various climate change scenarios on popular tourist destinations.

1. INTRODUCTION

Modeling tourism demand continues to be a popular issue in the tourism literature. In this line, multiple reviews by Lim (1999), Li et al. (2005) and Song and Li (2008) show that tourism demand estimation and forecasting is mainly focused on economic factors. At the same time, traditional demand studies have not considered utility theory in their decision making processes, being common the search of cross correlation between alternative time series in the framework of regression analysis.

There is no doubt that the consideration of the utility theory within the tourism decision context, formally described for the first time in Morley (1992), introduces a new framework allowing the consideration of both, different perspectives of travel decision and a larger set of explanatory variables. Thus, individuals or households with exactly the same socioeconomic and demographic characteristics may choose very different destinations. However, beyond the consideration of the utility theory by means of random utility models, it is generally recognized that there are taste differences among tourists and that final destination choice is not an independent decision, but the last decision of a set of choices that determine it. In this sense, it is argued that once tourists have decided to go on

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holiday, the budget and the mode of transportation, they chose the destination conditioned on their individual characteristics and on the attributes of the alternatives available in the choice set (Eugenio-Martin, 2003).

This new framework of modeling tourism demand from a microeconomic perspective can be of interest to different tourism stakeholders, such as tourism marketing analysts, because of the high potential for identifying the determinants of destination choice travel decisions. This analysis can reveal, for instance, that residents of a particular region are less interested in traveling than residents of other regions due to several aspects such as income disparities, differences in specified facilities for recreation, which may help residents to enjoy leisure time in their own place of residence, or differences in the attributes of the considered alternatives. Moreover, segmentation in the sample can be made to relate to any variable, and the relative importance for each segment of any variable can be compared. In any case, it should be noted how the destination choice is considered one of the most complex stage in the decisions tree for a tourists. Literature review reveals how the number of variables that may influence tourists can be very wide (Correia et al., 2007; Huybers, 2005; Nicolau and Más, 2005; Pestana et al., 2008; Thrane, 2008)

In this context, this study focuses on the role of temperature in travel decisions within the framework of Spanish domestic trips. Although Spain is known internationally by their importance in terms of international tourism (ranked often in the second place using data for international arrivals from the World Tourism Organitzation) the Spanish Tourism Satellite Accounts shows how domestic tourism in Spain accounts for more than half of the total contribution of the tourism sector to the GDP (estimated in a 10,7% for 2007).

The remainder of this paper is organized as follows. Section 2 reviews how the temperature has been used as a determining factor in travel decisions. Section 3 introduces the underpinnings and the methodology used. Data and results are presented in Section 4. Section 5 analyses how different climate scenarios could affect the destination choice in the context of domestic Spanish tourism. Finally, Section 6 concludes.

2. THE ROLE OF TEMPERATURE IN DETERMINING TOURISM TRIPS

Although climatic conditions had been used in tourism travel demand estimation exercises many years ago (Barry and O'Hagan, 1972), the interest in the relationship between tourism and climate has reemerged in recent years due to the growing concern for global warming. Academic literature has identified multiple interactions between tourism and climate, being the effect of climate change on tourism flows one of the most recurrent. This particular relationship can be analyzed from different perspectives.

Thus, a first group of studies aiming to assess the monetary effects of global warming and its consequences has considered tourism as an economic sector within the framework of computable general equilibrium models (Berrittella *et al.* 2006; Boselló *et al.*, 2005). A second group of studies has used time series to analyse tourism demand and their sensitiveness to climate conditions. Analytically, these time series models do not differ from traditional ones other than in the incorporation of climatic variables as elements that help to explain the demand. Examples of time series models considering domestic and international tourists' sensitivity to climate can be found in Agnew and Palutikof (2006), Bigano *et al.* (2005), Meyer and Dewar (1999), Moen and Fredman (2007), Rosselló et al. (2008) and Subak *et al.* (2000).

Finally, a third group is made up of studies that take into consideration the distribution of tourist, measured in terms of tourist numbers from a spatial point of view. From an aggregate perspective the redistribution of tourism flows was analyzed by Lise and Tol (2002) who studied Dutch tourists using factor and regression analysis to find optimal temperatures at travel destination for different tourists and different tourist activities, evidencing that under a scenario of gradual warming, tourists would probably spend their holidays in different places than they currently do. In a similar way Hamilton et al. (2005a and 2005b), Bigano et al. (2006) and Hamilton and Tol (2007) used regression models from the tourist flows tourists between more than two hundred countries and simulating the effects of different climate change scenarios. Although all this approaches can taken the aggregate perspective used in traditional tourism demand modelling exercises, searching single or multiple correlation between the magnitudes involved in the exercise, it is often argued that the underpinnings of the relationships between climate conditions and tourism decision can be derived from the utility theory. This perspective was taken in the pioneering study of Maddison (2001) who considered the individual's utility in reference to the number of visits to different destinations, characterized by a set of variables, the length of each of these visits, and consumption of a vector of other goods. Maddison (2001) measured wellbeing associated with changes in the climate at holiday destinations assuming the possibility of predicting changes in the number of trips to certain holiday destinations as a result of climate change.

Whatever the case, literature review reveals how, although other climatic variables can been used in determining the effect of climate and weather on tourism (Amelung et al. 2007), temperature has been the most popular by far because of their strong correlation with other climatic variables, their availability and maybe because is one of the continuous climatic variables that people first perceive (Hall and Higham, 2005; Becken and Hay, 2007; Giupponi and Shechter, 2003).

3. METHODOLOGY

Discrete choices, such as tourism destination choices, have been of interest to researchers for many years in a variety of disciplines (psychology, marketing, outdoor recreation, etc.). For this reason, probabilistic models based on the principle of utility maximization have been developed to model the choices undertaken by individuals from a set of mutually exclusive alternatives. However, as the true utilities derived from the different alternatives are not observable, they are considered random variables and, hence, the probability that an alternative is chosen is defined as the probability that it has the greatest utility among the available choice set (Ben-Akiva and Lerman, 1985).

More precisely, different approaches of the well-know random utility models, such as the conditional or the nested logit model, have been used to model destination choice decisions in different context (Train, 2003). However, a generalization of the standard logit model, known as the random parameter logit (RPL), has become very common to undertake this kind of analysis, specially because they allow researcher to account for the heterogeneous preferences of tourists in the discrete choice framework at the same time that allows the representation of different correlation patterns among non-independent alternatives (McFadden and Train, 2000; Nicolau and Mas, 2005).

Following McFadden (1974), the utility U_{ni} that a tourist n receives from choosing to visit destination i on a given choice occasion, when a choice set of $i=1,...,I$ alternatives exists, is assumed to take the form of the conditional indirect utility function which, following a lineal specification, can be expressed as:

$$U_{ni} = \beta_n^{'} x_{ni} + \varepsilon_{ni} \tag{1}$$

where $\beta_n^{'} x_{ni}$ is the nonstochastic portion of the indirect utility received during choice occasion if destination i is visited. Therefore, x_{ni} are observed attributes characterizing the alternatives available to tourists and β_n is the vector of estimated coefficients for tourist n representing his tastes. Finally, the error term ε_{ni} captures the variation in preferences among tourists in the population. As the individual is assumed to visit the destination yielding the greatest utility, the probability π_{ni} of choosing the ith alternative is:

$$\pi_{ni} = \Pr\left(\beta_n^{'} x_{ni} + \varepsilon_{ni} > \beta_n^{'} x_{nj} + \varepsilon_{nj}\right) \ \forall j \neq i \tag{2}$$

In addition, as it is usually assumed that the error term ε_{ni} is independent and identically distributed extreme value type I, the probability of choosing destination i in equation (2) can be expressed as (McFadden, 1978; Train, 2003):

$$\pi_{ni} = \frac{e^{\beta_n^{'} x_{ni}}}{\sum_{j=1}^{I} e^{\beta_n^{'} x_{nj}}} \tag{3}$$

As β_n is unknown by the researcher, a probability function for the coefficient vector has to be specified and the parameters of such distribution have to be estimated. In this way, by assuming that the coefficients of the explanatory variables vary randomly among tourists, the model account for preference heterogeneity regarding the variables included with random coefficients. At this point, although more complex distributions can be used, it is quite common to specify it as a normal $\beta \sim \mathrm{N}(b, W)$ with parameters b and W (Revelt and Train, 1998; McFadden and Train, 2000). Whichever distribution is used, the choice probability for tourist n visiting province i becomes the integral of expression (3), consequently:

$$\pi_{ni} = \int \left(\frac{e^{\beta_n^{'} x_{ni}}}{\sum_{j=1}^{I} e^{\beta_n^{'} x_{nj}}} \right) f(\beta) d\beta \tag{4}$$

Finally, the log-likelihood function for a given value of the parameter vector β takes the form:

$$LL(\beta) = \sum_{n=1}^{N} \sum_{i=1}^{I} y_{ni} \log \pi_{ni}(\beta) \tag{5}$$

where N represents the number of tourists in the sample, $\pi_{ni}(\beta)$ are the choice probabilities from equation (4) and y_{ni} equals one when the nth tourist chooses province i and 0 otherwise. As the solution to expression (5) involves the evaluation of a multiple-dimensional integral that does not have a closed-form, the estimation of such model requires the use of simulation methods such as, for instance, the simulated maximum likelihood estimation (Bhat, 1998; Revelt and Train, 1998).

Once the model has been estimated, the recovered parameter vector β can be used to simulate the destination choice probabilities in equation (3). In this way, this kind of discrete choice analysis are useful not only to explain the observed decisions of tourists, but also to evaluate the effects in the future of hypothetical changes in the explanatory variables (e.g. an increase in temperatures). Accordingly, section 5 uses different scenarios from the Intergovernmental Panel on Climate Change (IPCC, 2000) to investigate the impact of climate change on tourism demand and, specially, on coastal destination choices.

4. DATA AND RESULTS

4.1. Data

Data for this study comes from the Spanish Domestic and Outbound Tourism Survey (formally known as Familitur) carried out by the Spanish Institute of Tourism Studies. The target population includes all individuals living in first-home households throughout the whole Spanish territory, except the residents of Ceuta and Melilla. Information on all the trips undertaken by household residents in 2005 has been collected using a two-stage sampling scheme stratified by conglomerations with proportional selection of primary (censorial sections) and secondary units (first-home households). In this way, 12,400 households have been surveyed in each of the three sampling periods gathering data on the basic characteristics of the trips such as main destination, type of accommodation, means of transport, number of overnight stays, etc.

Familitur collects data at the individual level, that is, recording information from all the trips undertaken by each member of the household. Consequently, those trips undertaken jointly by different members of the household appear in the dataset more than once leading to a dataset including more than 120,000 individual-trips for 2005. However, given the household nature of vacation decisions, the household has become the basic unit of decision in this application. For this reason, the individual-trips dataset has been transformed to a household-trips level.

For the purpose of this study, only a subsample of the original dataset has been considered including interprovincial trips with the following characteristics:

1) whose destination was a coastal province (see Figure 1)
2) with a motivation related with leisure, recreation, holidays, or sports
3) undertaken during the high-season (June, July, August and September)
4) whose means of transport was by road (car, caravan, bus, train, motorcycle, etc)

The idea of these filters is triple. First, capture a climate sensitive typology of tourists (those whose visit coastline for leisure purposes). Second, guarantee the plausible choice set for those individuals included in the sample. And third, estimate an accurate travel cost for all alternatives and individuals. Moreover, given the low representativeness in the sample of trips to certain provinces (i.e. Asturias, Lugo, Pontevedra and Viscaya), the final sample for this application includes only trips undertaken to the 15 most visited provinces, that is, a total of 4,453 household-trips.

Figure 1. Spanish Peninsular coastal provinces

Source: own elaboration

To analyze all these trips to coastal provinces for leisure purposes, destination-specific data has been used to represent environmental characteristics and climatic variables. There is no doubt that, given the recreation nature of these trips, the availability of sandy beaches in the province or the number and length of its beaches will be important factors attracting visitors from other provinces (see Table 1 for more details on these variables). Destination-specific data has been aggregated at the province level from original data provided by the Ministry of the Environment and Rural and Marine Affairs. At the same time, as the climate of the area is expected to be also very relevant for tourists (Maddison, 2001), data on temperature, precipitation and humidity has also been considered using data from the Spanish National Atlas of the National Institute of Geography and the Meteorology Spanish Agency (AEMET). However, given the high correlation existent among these issues, the mean annual daytime temperature has been chosen as the most representative climatic variable to be included in the estimated model avoiding collinearity issues. The temperature of the capital of a province is assumed to be representative for the entire region.

Table 1. Description of the explanatory variables

Variable	Description
Travel cost	Total travel cost (in Euros)
Length	Total length of all beaches in the province (in meters)
Urban beach	Percentage of urban beaches (located near urban areas) in the province
Blue flag	Percentage of beaches in the province with a blue flag award
Anchorage	Percentage of beaches in the province with anchorage facilities
Gilded sand	= 1 if there are gilded sand beaches in the province
Temperature	Mean annual daytime temperature (in degrees Celsius)

Source: own elaboration

Finally, travel distance has also been calculated for each trip origin to the 15 available destination provinces, to be included as additional explanatory variables of destination choice. Cartographic data from the National Geographical Institute and the official roads map at scale 1:200,000 elaborated by the Promotion Ministry (Ministerio de Fomento) have been used to perform the calculation of distance measures and, to estimate the travel costs, a mileage cost of €0.19 per kilometer has been considered according to the official cost per kilometer dictated by the Spanish Government for 2005.

4.2. Results

The destination choice model described in section three has been estimated with the data presented above. MATLAB software has been used to maximize the simulated log-likelihood function with 200 replications per observation. Estimated results and some goodness-of-fit measures are provided in Table 2.

In general, the signs and magnitudes of estimated coefficients conform to expectations. In this way, while 'travel cost' and 'urban beach' have a negative effect on the probability of destination choice as shown by the negative sign of these variables, the 'length' of beaches, the percentage of 'blue flag' awarded beaches, the availability of 'anchorage' as well as 'gilded sand' beaches are desirable characteristics for tourists and, hence, increase the destination choice probability. In the same line, the mean annual daytime 'temperature' has been identified as one important factor explaining the choice of coastal destination for domestic tourism in Spain. A quadratic term has also been included in the model in order to bring into consideration the non-lineal effects of such variable on destination choice probabilities. In this way, while the positive coefficient of temperature gives evidence of the positive relationship between temperature and choice probability (i.e., destinations with higher mean annual temperature will have a higher probability of been visited), the negative and highly significant coefficient for the quadratic temperature variable shows the existence of a threshold level where the increase in temperature become undesirable.

Concerning the estimation search for variables with heterogeneous preferences, alternative specifications and distributions (normal, lognormal, etc.) have been investigated in the implementation of the random parameter model. However, the evidence suggests that, for the present dataset, only the consideration of the variable 'travel cost' as random parameter significantly improves model fit. For this reason, Table 2 presents the estimated mean and standard deviation parameters characterizing the normal distribution of the 'travel cost' coefficient.

Table 2. Destination choice model

Variable	Coefficient		Standard error
Travel cost (mean)	-1.6967		0.0447
Travel cost (st. dev.)	1.0004		0.0510
Length	0.0145		0.0006
Urban beach	-1.683		0.1931
Blue flag	0.5305		0.0647
Gilded sand	0.0931	(*)	0.0547
Anchorage	0.8827		0.0965
Temperature	3.1102		0.3824
Squared Temperature	-0.099		0.0126
Log-likelihood function	*-8557.8542*		
Restricted log-likelihood	*-11954.4000*		
McFadden-R^2	*0.2841*		
Adjusted McFadden-R^2	*0.2835*		

All estimated coefficients are statistically significant at a 1% level except those denoted by (*) which are significant at 10%.
Source: own elaboration

With regard to the goodness-of-fit of the model, the McFadden-R^2 (McFadden, 1974) and the adjusted McFadden-R^2 (Ben-Akiva and Lerman, 1985) measures have been calculated and included in Table 2. Although literature does not provide any standard or critical level to compare with, the values obtained by the destination choice model are similar to those found in other studies using similar models. Overall, the results can be considered satisfactory because the statistically significant estimates of the parameters are plausible, stable and robust to variations in model specification.

However, beyond the simple identification of the factors determining the choice of a tourist destination, the estimated model allows researchers to investigate the effects of hypothetical changes in the explanatory variables. In this way, next section will implement several simulation exercises to evaluate the impact caused by global warming on the choices undertaken by individuals in the context of coastal tourism.

5. Scenarios and Discussion

In a special report (IPCC, 2000), the Intergovernmental Panel on Climate Change presented multiple scenarios families to explore the uncertainties behind potential trends in global economic development and Greenhouse Gases (GHG) emissions. Each scenario was characterized (see Table 3) in terms of the potential evolution of political, social, cultural and educational conditions (e.g. how new technologies diffuse, how protection of local and regional environment is implemented, etc.).

Table 3. IPCC scenario characteristics

Variable	Scenario A1F1	Scenario B1
Population growth	Low	Low
GDP growth	Very high	High
Energy use	Very high	Low
Land-use changes	Low-medium	High
Resource availability (oil and gas)	High-medium	Low
Pace and direction of technological…	Rapid	Medium
…change favoring	Fossils	Efficiency and dematerialization

Source: adapted from IPCC (2000)

Based on these climate change scenarios, different Global Climate Models or General Circulation Models (GCMs) were implemented to derive a dataset (TYN SC1.0) providing alternative climate change projections on multiple variables (Mitchell et al., 2004). The dataset for Europe has been constructed using high-resolution grids (approximately 16 km × 16 km), containing mean monthly values for five climate variables (temperature, diurnal temperature range, precipitation, cloud cover and vapor pressure) from 2001–2100.

For this application, two climate change projections included in the TYN SC1.0 dataset based on two IPPC scenarios (A1F1 and B1) and the CGCM2 model developed by Flato and Boer (2001), have been used to investigate the effects of climate change on interprovincial domestic trips in Spain. More precisely, the predicted destination choice probabilities have been calculated for each coastal province under both climate change scenarios (see Table 4). In addition, the expected probabilities in the current situation have also been calculated for comparison purposes.

Table 4. Destination choice probabilities (%)

Province	Current situation	Scenario A1F1	Variation from current to A1F1 scenario	Scenario B1	Variation from current to B1 scenario
Alicante	11,58	13,58	17,27	13,45	16,11
Almería	4,65	2,42	-47,95	2,57	-44,79
Barcelona	7,65	6,27	-18,02	6,28	-17,84
Cádiz	8,81	6,13	-30,46	5,19	-41,07
Castellón	5,50	5,46	-0,71	5,26	-4,32
A Coruña	6,58	11,84	79,96	12,69	92,97
Girona	6,03	8,87	47,13	9,13	51,46
Granada	1,91	3,10	62,10	3,23	69,06
Guipúzcoa	4,58	6,67	45,42	6,70	46,22
Huelva	5,12	2,70	-47,38	3,38	-33,98
Málaga	5,78	3,49	-39,59	3,52	-39,03
Murcia	5,86	5,76	-1,73	5,32	-9,32
Cantabria	7,13	8,33	16,76	7,99	11,99
Tarragona	9,38	7,18	-23,44	7,23	-22,93
Valencia	9,43	8,21	-12,91	8,05	-14,62

Source: own elaboration

The variations in the destination choice probabilities from the actual situation to projected scenarios have been calculated and provided in Table 4. Overall, expected variations derived under both scenarios, A1F1 and B1, are similar in magnitude and direction. In this way, while climate change and the consequent increase in daytime temperatures will impact negatively on coastal provinces located in the South of Spain (especially Huelva, Cádiz, Málaga and Almería), coastal provinces in the North (A Coruña, Cantabria, Guipúzcoa and Girona) will experiment an important increase in their expected choice probabilities. At the same time, the impact of climate change on provinces in the East of Spain (Murcia, Alicante, Valencia, Castellón, Tarragona and Barcelona) shows a lower magnitude and a higher variability from province to province.

Following the results from the simulation undertaken in this application, the increase in mean annual daytime temperature caused by climate changes will lead to very different consequences for coastal provinces in Spain. In general terms, colder provinces in the North of Spain will benefit from the rising temperatures as far as they will become more attractive places to undertake high-season tourism trips. In contrast, provinces in the South, which already have a high temperature (specially in high-season months), will turn to be too warm for tourism activities and will experiment a decrease in the number of visitors. That is, the results obtained in this application predict a redistribution of trips within Spain coastal provinces from South and East to North. Anyway, it is important to note that all these results are only preliminary and further research is needed to achieve definitive conclusions.

6. CONCLUSION

In the current context of global warming, many tourism destinations are concerned not only with the impact of climate change on tourist industry and tourism demand, but also with the initiatives that can be implemented to tackle their negative economic repercussions. In this way, and although climate change will cause a large number of complex effects difficult to predict and evaluate in advance (sea level rise, sea-surface water warming, increasing extreme droughts, more frequent heat waves, extreme weather, etc.), the consequences of raising temperatures has been the subject of a particular scrutiny in the tourism specialized literature. In this line, and on the basis of utility theory, this application to domestic tourism in Spain has performed an analysis of the determinants of coastal destination choice highlighting the role of temperature on this tourism decision.

Beyond environmental attributes characterizing the beaches in the chosen destination (length, gilded sand, urban beaches, etc.) and travel costs, the analysis provided in this paper leads to the conclusion that climate (evaluated in terms of mean monthly temperature) is an important factor when tourist have to choice a coastal destination for they vacation trips. There is no doubt that rising temperatures will lead to drastic changes in tourist behavior because, following the obtained results, tourists will substitute one destination for another that fit better their preferences (also in terms of temperature and other climatic factors). Consequently, climate change will have a strong effect not only on tourism demand and tourism destination choices, but also on tourism supply and, specially, on coastal destinations and local providers.

More precisely, the empirical results from the random parameter model estimated in this application have identified temperature as a positive factor determining the probability of visiting a specific coastal destination. A non-lineal effect of temperature on choice probabilities have been identified showing the existence of a threshold level where rising temperatures turn coastal provinces an undesirable place to undertake tourism activities. Anyway, beyond the findings achieved in this paper further research is needed to provide a more comprehensive interpretation of the impacts of climate change on tourism demand, the existence of non-lineal effects on climate variables and the relationship between climate and tourism seasonality.

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