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Climate change and summer mass tourism: the case of Spanish domestic tourism

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Abstract This paper investigates the impact of climate change on destination choice decisions in a context of domestic coastal tourism in Spain. Destinations are characterized in terms of travel cost and coastal 'attractors', such as temperature and beach-related attributes. By means of a discrete choice model based on the random utility theory, these variables are used to explain the observed pattern of interprovincial domestic trips, showing trade-offs between temperature and attractiveness in the probability of a particular destination being chosen. The model is used to investigate the impact of two climate change scenarios on the allocation of domestic tourism within Spain. The findings show that while Spain's northern colder provinces would benefit from rising temperatures, provinces in the south would experience a decrease in the frequency of trips.

1 Introduction

Certain tourism markets such as winter sports or sun, sea and sand mass tourism are highly sensitive to changing climatic conditions (temperature, rainfall etc.). However, in spite of the important contribution of the tourism sector to the economy, research on the effects of climate change on the field has only recently emerged. Since the first qualitative approximations (Nicholls and Hoozemans 1996; Gable 1997; Wall 1998), a need for instruments that can measure changes in tourism demand has led to the development of different quantitative methods (Scott et al. 2005, 2007; Hamilton et al. 2005a; Hamilton and Tol 2006).

Among the quantitative approaches used to evaluate the effects of climate change on tourism demand, the estimation of its impact in terms of tourist numbers has become the most popular one. Within the framework of winter tourism, studies often rely on the evaluation of physical conditions that make certain tourism activities feasible (Harrison et

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al. 1999; Elsasser and Bürki 2002; Scott et al. 2007). Although this approach can be replicated using a Tourism Climate Index (Amelung et al. 2007), investigations have mainly centered on quantifying the relationship between tourism demand and certain climatic variables in order to project future climate scenarios. For instance, several time series analyses have considered the use of different weather conditions as tourism flow predictors (Subak et al. 2000; Agnew and Palutikof 2006; Rosselló 2011; Rosselló et al. 2011), showing the significance of weather variability in explaining tourism departures.

However, cross-sectional analyses instead of time series have often been preferred when estimating the role of climate in determining tourism flows because of the long perspective that is required when analyzing climate change impacts. In this line, Maddison (2001) investigates the impact of climate change on the chosen destinations of British tourists, using classical price determinants of tourism demand and incorporating climatic variables in terms of attractors, showing the significant effect of temperature on tourism trips. Lise and Tol (2002) study Dutch tourists, using a factor and regression analysis to find optimal temperatures at travel destinations for different tourists and different tourism activities. From their results, tourists from OECD countries show a preference for an average temperature of 21 °C for the hottest month of the year, indicating that, in a scenario of gradual warming, tourists will spend their holidays in different places from those currently chosen. The redistribution of international tourism flows is analyzed in Hamilton et al. (2005a,b), Bigano et al. (2006a) and Hamilton and Tol (2007), using simulation models to predict tourism departures and arrivals under alternative climate change scenarios.

Using data for 207 countries, Hamilton et al. (2005a,b) analyze the impact on international arrivals and departures through changes in population, per capita income and climate change, showing that the expected growth of tourism is smaller under a global warming scenario. Bigano et al. (2006a) analyze tourism flows from 45 countries using distance, political instability and poverty, annual average temperature, and a preference for coastal areas, including the alternative possibility of domestic tourism. The results show the existence of a preferred holiday climate for all tourists, independent of their home climate, with a more pronounced preference in the case of tourists from hotter climes. Finally Hamilton and Tol (2007) investigate the impact of different climate change scenarios at a regional level for Germany, Ireland and the UK, considering the national magnitudes for domestic and international tourism. However, as the data at a regional level covers the destinations but not the tourists' place of origin, it was necessary to downscale the results from a national level to a regional one.

From this review, three significant gaps can be identified. First, although for some countries domestic tourism is more important than international tourism (Bigano et al. 2004), the former has only been analyzed as an alternative to international tourism but not by itself. For this reason, given the frequent lack of information on domestic tourism, no studies focusing solely on this type of tourism have been found in literature. Second, in analyses of the redistribution of tourism flows, previous quantitative models have considered annual temperatures, without it being possible to include intra-annual temperature variations for a particular destination. Third, although it seems to be generally accepted that sun and sand tourism is responsible for major international tourism movements, the behavior of this market segment within a context of climate change has never been specifically analyzed.

Using data from the Spanish Domestic and Outbound Tourism Survey (Familitur), this study aims to fill these gaps by analyzing the role of monthly temperature in summer domestic trips taken by Spanish residents to coastal provinces. According to the Spanish Tourism Satellite Accounts, the tourism sector contributed to the GDP in a 10.2 % in 2010. Although Spain is famous worldwide for the relevance of its international tourism sector (ranking second according to arrivals data by the World Tourism Organization), it is important to highlight that domestic tourism contributes more to the GDP than international tourism. Domestic coastal trips by Spaniards from June to September have therefore been modeled using a random utility model where the choice of a given destination has been explained on the basis of destination-specific attributes, including monthly temperatures.

Additionally, while previous literature analyzing coastal trips has made use of tourism climate indices based on individual's opinions about different climatic indicators (see, for instance, Moreno and Amelung 2009), this paper focuses on the observed behavior of individuals when choosing a tourism destination. In this way, combining the current and future values of climatic indicators it is possible to evaluate (and project) the optimal condition for developing tourism activities.

The remainder of this paper is organized as follows. Section 2 provides a review of tourism demand modeling and the role of climatic variables in determining tourism trips. Section 3 presents data for the Spanish case study and section 4 outlines the results. Section 5 extends the aforementioned analysis by considering different climate change scenarios and their implication on the Spanish domestic tourism market. Lastly, section 6 contains the final conclusions.

2 Tourism demand modeling and climatic determinants

Tourism demand modeling continues to be a popular issue in tourism literature. However, multiple reviews by Lim (1999), Li et al. (2005) and Song and Li (2008) show that tourism demand estimation and forecasting mainly focuses on economic factors. At the same time, traditional demand studies have not considered the utility theory in their decision-making processes, with a search for cross correlations between alternative time series being common within the framework of regression analyses.

There can be no doubt that by taking the utility theory into account within the context of tourism decisions, as formally described for the first time in Morley (1992), a new framework is introduced that allows different perspectives of travel decisions and a larger set of explanatory variables to be considered. Thus individuals or households with exactly the same socioeconomic and demographic characteristics might choose very different destinations. However, over and above the consideration of the utility theory through the use of random utility models, it is generally recognized that tourists have different tastes and that choosing a final destination is not an independent decision, but the last decision of a set of choices. In this sense, it is argued that once tourists have decided to go on holiday and established a budget and mode of transport, they choose a destination conditional upon their preferences and the attributes characterizing the alternatives in the choice set (Eugenio-Martin 2003).

This new framework for modeling tourism demand from a microeconomic perspective has become of interest to different tourism stakeholders, such as tourism marketing analysts, because of the high potential for identifying the determinants of destination choice decisions. This analysis can reveal, for instance, that residents of a particular region are less interested in travelling than residents of other regions due to several aspects, such as income disparities, differences in available recreational facilities which may allow residents to spend their leisure time in their own place of residence, or differences in the attributes of the considered alternatives. Moreover, different types of segmentation can be implemented to evaluate the effect of the explanatory variables on each specific segment of the sample.

It is important to highlight that choosing a destination is considered to be one of the most complex stages in the decision process by tourists, with a wide number of variables (dependent on the aim of the study) that may influence such decisions (Correia et al.

2007; Huybers 2005; Nicolau and Más 2005; Pestana et al. 2008; Thrane 2008). Of special interest for this study is the re-emerging awareness among researchers of climate as a determinant of tourism choices, due to the growing concern about global warming. In fact, recent reviews of literature reveal that temperature is the most commonly used climatic variable in explaining tourism decisions because it has the greatest influence on tourism flows, compared with other climatic variables (Agnew and Palutikof 2001). Although other climatic variables, like rainfall, wet days, cloud cover, humidity, sunshine and wind speed, can also be found in literature, their exclusion from empirical applications can be tied in with their strong correlation with temperature and the fact that temperature is the most popular climatic variable to first be perceived by people. Also, from a practical point of view, within the context of climate change analyses, temperature projections are easily available compared with other climatic variables.

Alternative ways of including temperature have been used with similar results, for instance the annual average temperature (Bigano et al. 2006a; Hamilton at al. 2005a,b; Hamilton and Tol 2007), quarterly maximum temperatures (Maddison 2001), average temperatures for the warmest month (Lise and Tol 2002), and drought and heat waves derived from the monthly maximum and minimum temperature variables (Rosselló et al. 2011). Overall, this work analyses the role of different monthly local climate indicators with special emphasis on average temperatures as a relevant factor in explaining tourism trips. A random utility model will be implemented to explain the tourism destination choices of Spanish residents (see Supplement for more detail on the theoretical specification of the model).

3 Data

The data for this study is taken from the Spanish Domestic and Outbound Tourism Survey (Familitur) conducted by the Spanish Institute of Tourism Studies. The target population of this survey includes all individuals living in first-home households throughout the whole Spanish territory, except residents of Ceuta and Melilla. Information concerning all trips undertaken by household residents in 2005 was 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 were surveyed in each of the three sampling periods, gathering data on the basic characteristics of the trips, such as the main destination, type of accommodation, means of transport, number of overnight stays, etc.

Familitur collects data at individual level, recording information about all trips undertaken by each member of a household. Consequently, trips undertaken jointly by different members of a household appear in the dataset more than once, leading to a dataset including more than 120,000 individual trips for 2005.[1] However, given the household nature of vacation decisions (Eugenio-Martín 2003), households were taken as the basic unit of decision-making for this application. For this reason, the original individual-trip dataset was transformed to a household-trip level. In this transformation process, one individual was chosen as the representative member for each household and his/her information was used to summarize the trip of the whole household.

Given the special purpose of this study –focused on the investigation of the effect of climate change on sun and sand mass tourism–, and because Familitur collects data about all

[1] Full survey results can be downloaded at http://www.iet.tourspain.es/es-ES/estadisticas/familitur/informesdinamicos/paginas/anual.aspx (accessed on December 5th 2011)

trips taken by Spanish households (e.g. study trips, conventions, city breaks, sports travel, visits to friends or relatives, etc.), it was necessary to use some filters to identify the observations (i.e. trips) from Familitur that should be considered in the application. In this way, only interprovincial trips with the following characteristics were included in the final sample[2]:

1) Trips whose destination was a coastal province (see figure Figure 1 with the geographical distribution of the Spanish peninsular coastal provinces).
2) Trips with a motivation related to leisure, recreation, holidays, or sports.
3) Trips undertaken during the high season (June, July, August and September), when the favorable meteorological conditions allow tourists to enjoy recreational activities on the beach.

The idea behind the use of these filters is to capture a climate-sensitive type of tourist (those who visit coastal areas for leisure purposes), often identified as mass tourism or sun and sand tourism (Aguiló et al. 2005), and guarantee a plausible choice set for those individuals included in the sample.

Additionally, as travel cost to the chosen destination is expected to be one of the most important determinants of tourism destination choice, it is necessary to collect data on this issue to allow its consideration as an additional explanatory factor in the model. However, Familitur does not provide information about travel cost faced by individuals and, consequently, these expenses have been inferred, as explained below with more detail, from the distance travelled by individuals between their place of residence and the destination. In this line, in order to estimate accurate travel costs for all the considered alternatives, only those trips using a road-based means of transport (i.e. car, caravan, bus, motorcycle, etc.) were considered.

By focusing on road-based trips, which represent the 89.93 % of the sample, two well-known destinations are excluded from the analysis: the Balearic Islands and the Canary Islands. At this point, it has to be highlighted that although both of them are popular international tourism destinations, they only represent the 5.4 % of summer domestic tourism in Spain (2.2 % in the case of the Balearic Islands and 3.2 % in the case of the Canary Islands). Furthermore, following similar exercises (Phaneuf and Smith 2005; Bujosa and Riera 2009), those provinces with a share of visits lower than 1 % (Asturias, Lugo, Pontevedra and Viscaya) were excluded to guarantee representativeness requirements for all the alternatives included in the choice set. As a result, taking into account all road-based trips to the 15 most visited coastal provinces in Spain, the final sample for this application includes 4,453 household trips.

To analyze all these trips to coastal provinces for leisure purposes, destination-specific data was used to represent environmental characteristics and climatic variables. Given the recreational nature of these trips, the availability of sandy beaches in the province, the number and length of these beaches or its main characteristics (color of the sand, facilities, accessibility, etc.) will be important factors in attracting visitors from other provinces. However, in spite of the large number of variables initially considered during the estimation of the model, only some of them have become statistically significant in the final model

[2] The characteristics (e.g. length, costs, means of transport, accommodation, etc.) of trips taken to local destinations (in the same province) tend to be different from the characteristics of interprovincial trips (and also from international trips). For this reason, it is quite common to consider that local and interprovincial destinations show different levels of substitution and, hence, cannot be mixed in the same choice-set. Consequently, all trips taken to the same province were excluded from the dataset to guarantee a plausible choice set composed by real substitute interprovincial alternatives shared by all individuals.

Fig. 1 Spanish Peninsular coastal provinces

presented in the next section (see Table 1 for more details and some descriptive statistics on these variables). The destination-specific data was aggregated at a provincial 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 also expected to be very important for sun and sand tourists, data on temperatures, precipitation and humidity for the high season period was also considered using TYN SC1.0 data from the Tyndall Centre for Climate

Table 1 Descriptive statistics of explanatory variables

Variable	Description	Mean	SD	Min	Max
Length	Total length of all beaches in the province (in kilometers)	87.88	39.19	15.02	149.35
Urban beach	Share of urban beaches (located near urban areas) in the province	0.41	0.15	0.23	0.78
Blue flag	Share of beaches in the province with a blue flag award	0.38	0.37	0.06	1.00
Anchorage	Share of beaches in the province with anchorage facilities	0.19	0.21	0	0.74
High season temp.	Mean daytime temperature for high season months including June, July, August and September (in degrees Celsius)	22.51	2.18	18.15	24.48
Temp. June	Mean daytime temperature for June (in degrees Celsius)	20.65	2.01	16.50	22.60
Temp. July	Mean daytime temperature for July (in degrees Celsius)	23.67	2.34	19.00	25.60
Temp. August	Mean daytime temperature for August (in degrees Celsius)	23.92	2.43	19.20	26.10
Temp. September	Mean daytime temperature for September (in degrees Celsius)	21.77	2.00	17.80	23.80
Travel cost	Round-trip travel cost (in hundreds of Euros)	2.81	1.31	0.12	5.96

Change Research (Mitchell et al. 2004).[3] Although precipitation, humidity and maximum temperatures were initially considered, given the high correlation between these variables and average temperatures, the latter was chosen as the most representative climatic variable to be included in the estimated model to avoid collinearity issues.[4]

Two alternative specifications are explored to capture potential differences in the effects caused by the temperature on the destination choice process depending on the month when the trip was taken. In the first model, only the average high season temperature (from June to September) is included. In the second one, monthly mean temperatures are used by means of four interaction variables (one for each summer month), between monthly mean temperature and a set of four artificial variables indicating whether the trip had taken place in each summer months (June, July, August and September). Consequently, for each observation, only the interaction corresponding to the month when the trip was taken equals the temperature on that month and the remaining interactions take value equal to zero.

Finally, travel distances were also calculated for each trip, from the municipality of residence of each household to the 15 coastal destination provinces, using a Geographical Information System and data from the National Geographical Institute and official road maps on a scale of 1:200,000, drawn up by the Ministry of Public Works (Ministerio de Fomento). Round-trip travel costs were calculated using these distances and taking a mileage cost of €0.19 per kilometer according to the official cost per kilometer for 2005 laid down by the Spanish Government.

4 Results

Two specifications of the destination choice model, one including the mean high season temperature and the other considering the monthly mean temperature, were estimated using the data presented above. MATLAB software was used to maximize the simulated log-likelihood function with 200 Halton draws. The estimated results of both models and some goodness-of-fit measures are provided in Table 2.

The signs and magnitudes of estimated coefficients conform to expectations and, in general, their interpretation across both models is similar. While the 'travel cost' and 'urban beach' variables have a negative effect on the destination choice probability, as shown by the negative sign of these variables, the 'length' of beaches, share of 'blue flag' rated beaches, and availability of 'anchorage' are desirable characteristics for tourists and hence increase the destination choice probability. In the same way, the average daytime 'temperature' has been identified as one important factor explaining the choice of coastal destination for domestic tourism in Spain. The comparison between the model including the mean high season temperature and the model including the monthly mean temperatures provides evidence of the different effect caused by temperature on destination choice over different months. In this way, although the coefficients of all these variables are positive, it is observed as temperature is a more important factor being considered in trips taken during July and August –this means that, for instance, people tend to be more sensible to temperature in August than in other months–, and it has a lower effect for trips taken in September and June. In fact, the estimated coefficient for this last month is not statistically significant.

[3] This data can be downloaded at http://www.cru.uea.ac.uk/cru/data/hrg/. Accessed on December 5th 2011.
[4] The correlation matrix including all explanatory variables is available from the authors upon request.

Table 2 Destination choice model

Variable	Mean high season temperature		Monthly mean temperature	
	Coef.	Std. err.	Coef.	Std. err.
Length	0.0154	0.0006	0.0153	0.0006
Urban beach	−1.2071	0.1765	−1.2303	0.1780
Blue flag	0.5612	0.0595	0.5707	0.0594
Anchorage	0.5954	0.0901	0.6396	0.0898
Mean high seson Temp	4.3294	0.3994		
Squared high season Temp	−0.0974	0.0091		
Temp June			1.2285$^{(+)}$	0.7865
Squared Temp June			−0.0288$^{(+)}$	0.0200
Temp July			4.9278	0.6997
Squared Temp July			−0.1070	0.0154
Temp August			4.5767	0.5643
Squared Temp August			−0.0957	0.0120
Temp September			4.2979	0.9223
Squared Temp September			−0.0994	0.0216
Travel cost	−1.7840	0.0493	−1.7840	0.0489
Coef. st. dev.				
Mean high season Temp	−0.2786	0.0380		
Temp July			−0.2223	0.0626
Temp August			−0.3690	0.0515
Temp September			0.3163	0.0950
Travel cost	1.0021	0.0509	0.9943	0.0512
Log-likelihood function	−8529.9831		−8518.5629	
Restricted log-likelihood	−11954.4000		−11954.4000	
McFadden-R^2	0.2865		0.2874	
Adjusted McFadden-R^2	0.2859		0.2863	
Number of observations	4,453		4,453	

All estimated coefficients are statistically significant at a 1 % level except those denoted by $^{(+)}$ which are not significant.

A quadratic term was also included for the temperature variables in order to take into consideration the non-linear effects of this variable on destination choice probabilities as is often the norm in similar exercises (Maddison 2001; Lise and Tol 2002; Hamilton et al. 2005a, b; Bigano et al. 2006b; Hamilton and Tol 2007). In this way, while a positive temperature coefficient provides evidence of a positive relationship between temperature and choice probability (i.e. destinations with a higher temperature will have a higher probability of been visited), a highly significant negative coefficient for the quadratic temperature variable shows the existence of a threshold level where an increase in temperature becomes undesirable.

Regarding the search for variables with heterogeneous preferences, alternative specifications and distributions (normal, lognormal, etc.) were investigated in the implementation process of the random parameter model. However, evidence suggests that, for the present dataset, only the consideration of temperatures and travel cost as random parameters significantly improves the model's fit. For this reason, Table 2 presents the estimated mean and standard deviation parameters characterizing the normal distribution of the temperatures and travel cost coefficients.[5]

With regard to the goodness-of-fit of the model, the McFadden-R^2 (McFadden 1974) and adjusted McFadden-R^2 (Ben-Akiva and Lerman 1985) measures were calculated and included in Table 2. Although literature does not provide any standard or critical level for comparative purposes, the values obtained by both specifications 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 the model's specification.

As commented above, beyond the mere identification of those factors that determine destination choice, the estimated models allow researchers to investigate the effects of hypothetical changes in the explanatory variables. The next section will therefore implement several simulation exercises, based on the monthly mean temperatures specification, to evaluate the impact of temperature warming on the choices undertaken by individuals in the context of summer coastal tourism.

5 Scenarios and discussion

In a special report (IPCC 2000), the Intergovernmental Panel on Climate Change presented multiple scenario families to explore the uncertainties behind potential trends in global economic development and greenhouse gas emissions. Each scenario was characterized in terms of the potential evolution of political, social, cultural and educational conditions (Table 3). Although alternative scenarios have been developed and published more recently, the difficult access to detailed data from their projections and the popularity and extensive use of the scenarios provided in the IPCC (2000) special report justify the use of the last ones to illustrate this application.

Based on these climate change scenarios and on different Global Climate Models or General Circulation Models (GCMs), the Tyndall Centre for Climate Change Research derived the TYN SC1.0 dataset providing alternative climate change projections on multiple variables (Mitchell et al. 2004). The dataset for Europe was 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) for the period 2001–2100.

For this application, two climate change projections included in the TYN SC1.0 dataset, based on two IPPC scenarios (A1FI and B1), and the CGCM2 model developed by Flato and Boer (2001) were used to investigate the effects of climate change on interprovincial domestic trips in Spain for 2050. On the one hand, the A1 storyline assumes a world of very rapid economic growth, a global population that peaks in mid-century and a rapid introduction of new and more efficient technologies. The A1 scenario is divided into three different groups that describe alternative directions of technological change being A1FI the option of characterized by the intensive use of fossil energy. On the other hand, B1 describes

[5] The use of micro data can lead to serious heteroskedasticity problems in models explaining tourism expenditure or the number of tourism trips taken by households. However, the potential for heteroskedasticity in the context of discrete choice models is low. Additionally, following Munizaga et al. (2000), the models of the logit family (as the one used in the application) are able to recover accurately all parameters of the utility function even when heteroskedasticity is present.

Table 3 IPCC scenario characteristics

Variable	Scenario A1FI	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)

a convergent world, with the same global population as A1, but with faster changes in economic structures toward a service and information economy.

The predicted destination choice probabilities were calculated for each coastal province based on the monthly mean temperatures model presented in section 4 and both climate change scenarios described above (see Table 4). It is important to highlight that these projections are exclusively taking into consideration the temperature variations predicted by the A1FI and B1 scenarios and, hence, assume unchanged the remaining explanatory variables included in the model and other factors that could affect the destination choice process such as the provinces included in the choice-set, the month the trip takes place, etc.

The expected probabilities for the current situation were also calculated for comparative purposes and the variations in the destination choice probabilities between the current situation and the projected scenarios were calculated and provided in Table 4. Overall, the expected variations under scenarios A1FI and B1 are similar in magnitude and direction. While climate change and the consequent increase in daytime temperatures will impact

Table 4 Simulated destination choice probabilities

Province	Current situation (%)	Scenario A1FI (%)	Variation from current to A1FI scenario	Scenario B1 (%)	Variation from current to B1 scenario
Alicante	13.16	15.52	2.35	17.77	4.61
Almería	4.23	0.71	−3.51	0.60	−3.63
Barcelona	8.28	7.89	−0.38	5.14	−3.14
Cádiz	8.52	8.97	0.45	10.08	1.56
Castellón	5.85	9.86	4.01	9.41	3.56
A Coruña	5.86	8.06	2.20	7.35	1.49
Girona	6.40	8.78	2.38	12.01	5.61
Granada	2.04	1.11	−0.93	1.19	−0.85
Guipúzcoa	5.30	7.73	2.43	8.50	3.20
Huelva	3.96	0.60	−3.36	2.02	−1.94
Málaga	6.24	1.30	−4.94	0.81	−5.43
Murcia	4.90	5.06	0.16	3.04	−1.86
Cantabria	6.11	6.02	−0.08	3.40	−2.71
Tarragona	9.70	4.59	−5.11	4.61	−5.09
Valencia	9.45	13.78	4.34	14.07	4.62

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 experience a big increase in their expected choice probabilities. At the same time, the impact of climate change on provinces in eastern Spain (Murcia, Alicante, Valencia, Castellón, Tarragona and Barcelona) shows a lower magnitude and higher variability from province to province.

Based on the results of the simulation undertaken in this application, the increase in mean monthly daytime temperatures caused by climate change will lead to very different consequences for coastal provinces in Spain. In general terms, colder provinces in the north of Spain will benefit from rising temperatures insofar as they will become more attractive places for high-season tourism trips. In contrast, provinces in the south will experience a reduction in visitors, caused by an increasing number of emerging competitors in the north. Overall, the results of this study predict a redistribution of domestic tourism travel within Spain's coastal provinces, with a shift from southern and eastern Spain to northern Spain. It is important to note that these results are only based on temperature variations and hence the effects of changes under other climate-sensitive conditions (e.g. land cover, sea level rise, biodiversity, etc.) that might be jointly altered in the presence of higher temperatures were not considered. At the same time, as the simulation exercise assumes no changes in the destinations available to tourists, no transfers between domestic and international tourism can occur. This means that, for instance, it is not possible to observe an actual domestic tourist from the north of Spain visiting the south of France under a scenario of warmer temperatures.

6 Conclusions

Many tourism destinations are calling for initiatives, such as the implementation of mitigation and adaptation policies, to tackle the negative economic repercussions of climate change (Becken 2005). Within this context, leaving aside the first qualitative studies that dominated literature during the nineties, the tourism industry has a serious need of data and quantitative studies that could provide new information on how climate change will modify tourism demand. To fill this gap, different approaches have been developed during the last few years to analyze the global effects of climate change on international tourism movements. However, for those countries where domestic tourism accounts for the majority of the tourism market, big uncertainties still remain unsolved.

On the basis of utility theory, this paper presents an application of a discrete choice model where domestic summer trips to the Spanish coast are characterized in terms of travel costs and environmental destination-specific attributes. The results show that temperature plays a central role in explaining the observed pattern of road-based interprovincial trips. More precisely, the empirical results of the random parameter model estimated in this study identified temperature as being a positive factor in determining the probability of visit a specific coastal destination. However, the non-linear effect of temperature on choice probabilities highlights the existence of a threshold level where rising temperatures lead to a reduction in the probability of a particular destination being chosen.

The estimated model and two climate change scenarios provided by the IPCC (A1FI and B1) were used to evaluate the reallocation of tourism in Spanish coastal areas. The results show that the expected increase in temperatures will negatively affect those provinces located on the southern coast of Spain in terms of expected choice probabilities, while northern coastal provinces will benefit from this increase. Meanwhile, in general the impact of these rising temperatures on Spain's eastern provinces is lower, with a higher variability.

Results from this paper go in the same line as those pointed out by Moreno and Amelung (2009) using a tourism climate index, showing an increase of the beach tourism climate index for the northern Spanish provinces and a decrease for the southern ones. However, while Moreno and Amelung (2009) attribute the loss of attractiveness of southern provinces to extremely hot conditions, the results obtained in this paper only show that, in the presence of warmer temperatures, Spaniards will have also into consideration northern coastal provinces for their summer trips in addition to the traditional southern ones. From this view, while it is not possible to confirm that southern provinces will be too hot for summer tourism, results show that new competitors will emerge (the northern provinces), explaining the change in the actual distribution of domestic coastal summer trips.

Multiple implications for public and private institutions can be derived from these results. Given the rise in their attractiveness as summer holiday locations, northern Spanish provinces should learn from the experience of southern ones in managing tourism development. In contrast, in view of the increasing competition that Northern provinces could represent, southern Spanish provinces should focus their efforts on the diversification of their current tourism product, mainly based on good climatic conditions. At the same time, due to their waning appeal as summer holiday destinations, the spring and autumn months should be evaluated as alternative holiday seasons that offer a higher comparative advantage.

However, it is important to highlight that these projections are based exclusively on temperature variations and, consequently, they do not consider the effects of changes in other climatic variables or other nature-related tourism attractors that could be affected by global warming. Further research is needed to analyze the role of these factors and to extend the analysis to other segments that could also be climate sensitive in addition to summer mass tourism.

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