Climate Change

The impact of climate change on tourism demand in Spain

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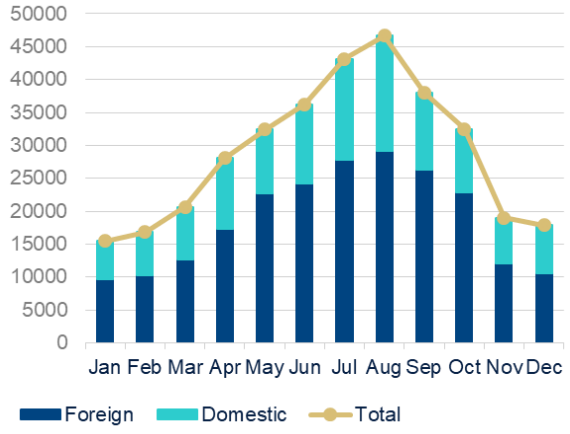
Tourism in Spain is largely driven by climate conditions, with its coastal regions attracting millions of visitors each year. However, as global temperatures rise, the traditional appeal of these destinations may diminish, leading to shifts in tourism demand that could have far-reaching economic consequences. The study "The Impact of Climate Change on Tourism Demand" builds on existing literature by offering a granular analysis of how specific provinces in Spain may be affected by changes in climate conditions, serving as a reference for adaptation policies.

Tourism, a crucial sector for the Spanish economy, is also vulnerable to climate change effects. Variations in temperature, precipitation patterns and the frequency of extreme weather events can profoundly affect tourism demand and the attractiveness of destinations. The study conducted by BBVA Research analyzes the impact of the current climatic conditions on tourism demand in Spanish provinces, according to different types of tourism, as well as the potential effects of future climate changes under alternative GHG emission concentration scenarios.

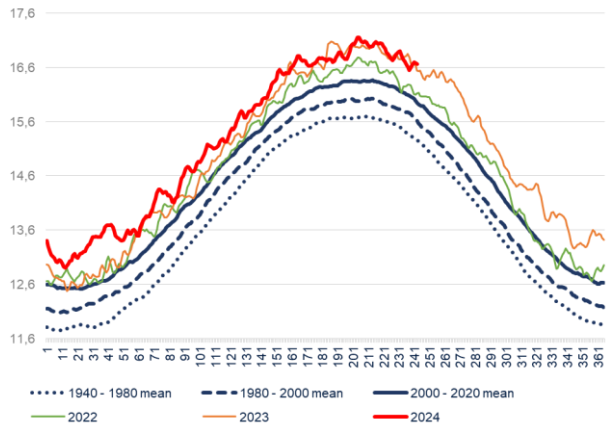
The relevance of the climate-tourism relationship in Spain is twofold. Firstly, tourism is one of the main economic activities, accounting by 11.6% of GDP and 9.3% of employment in 2022, and secondly, tourism demand presents a marked seasonality in Spain, with a peak in summer and high concentration in foreign tourism seeking sun and beach (see **Figures 1 and 2**).

Figure 1. **BEDNIGHTS PER MONTH IN SPAIN** (2023, THOUSANDS)



Source: BBVA Research from INE.

Figure 2. **DAILY WORLD TEMPERATURE** (1940-PRESENT, ºC)



Source: BBVA Research from Daily 2-meter Air Temperature.

Analysis of climate conditions and tourism demand: challenges and contributions. The analysis of the impact of climate conditions on tourism is challenging, particularly in terms of appropriate indicators and how to measure the multifaceted impacts on tourism of the "climate comfort". Despite these challenges, the study aims to contribute

to the existing literature[1] in several key ways. First, it offers a granular, **provincial-level** analysis, of climatic conditions impact on tourism demand, allowing for a deeper understanding of how provinces in Spain may be affected differently, specially recognizing different **types of tourism[2]** (the effects on ski resorts will differ from those on beach destinations or urban sightseeing). Second, tourism demand is measured through the number of bed nights spent at hotel accommodation, with estimates for **total and foreign demand**, since foreign tourists are likely more sensitive to climate-related conditions than domestic tourists, while for the latter distance is one of the main variables influencing the choice of destination. Third, the research employs **two different climate indices** to assess how climatic conditions influence tourism demand. namely the Tourism Climate Index (TCI) and the Holiday Climate Index (HCI). This dual approach enhances the robustness of the findings by capturing different dimensions of climatic comfort relevant to tourism. Finally, the study examines both the impact of historical climate data (2002-2023) as well as the potential future impact of climate change on tourism demand up to 2100, holding other factors constant (ceteris paribus), across different climate scenarios. This gives valuable insights into the **potential long-term impacts** of climate change on Spain's tourism sector, while serving as a reference for defining the necessary strategies to improve the resilience of the tourism sector. For more details on the methodology see **Box 1**.

Climate comfort is a key driver of tourism demand. The analysis reveals that higher climate comfort is associated with an increase in monthly tourism flows, with different effects by type of tourism segments. In Spain, coastal areas are the most sensitive, particularly those along the Mediterranean coast and islands -an increase (decrease) of 1% in the TCI results in a 0.5% increase (decrease) in bed nights for these provinces-, followed by Northern coastal ones and Mountains and Nature tourism, while urban areas are relatively inelastic to changes in climate conditions (with an elasticity around 0.06%), possibly due to a substitution effect between coastal and urban destinations.

Economic factors and seasonal patterns also influence the choice of tourist destination. Economic factors, such as real GDP, exhibit a positive significant impact on bed nights, while destination price elasticity is negative, confirming that higher prices reduce tourism demand. The relative foreign real GDP per capita also positively affects tourism, indicating that increased relative purchasing power of foreign tourists enhances external tourism demand in Spain. Seasonal patterns of tourism have also been considered, revealing that summer has a substantial positive effect on bed nights, while winter has a negative impact.[3] Similar results are obtained when considering only the foreign demand, despite higher elasticity - i.e., foreign tourism is more sensitive to climate conditions -.

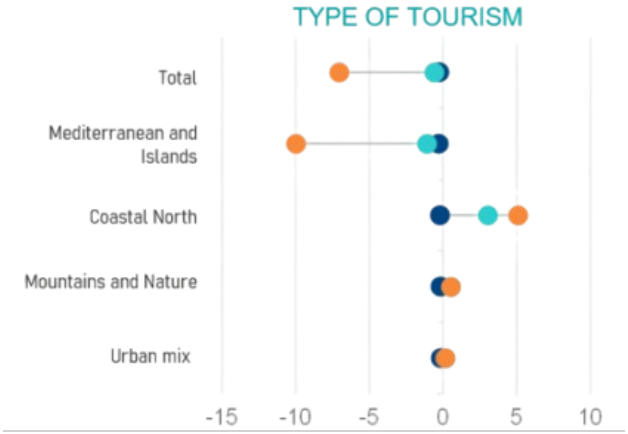
Looking ahead, climate change will become a major driving factor in the seasonal and geographical distribution of tourism demand. By the end of the century, the results reveal a clear North-South-East pattern in coastal tourism demand changes, where Northern coastal provinces benefit from changes in climate change and Southern and Eastern regions experience notable declines in tourism demand, especially under higher warming scenarios, while city tourism shows a less pronounced impact. Under a net zero scenario (RCP 2.6)[4], the net impact is expected to be minimal (-0.3% in 2100 vs. 2024-2030), but as temperature projections rise, the negative impact becomes more pronounced, particularly in summer months when extreme heat may deter visitors from traditionally popular destinations. In a scenario of low to moderate future emissions, compatible with a temperature increase of 2.8ºC by 2100 compared to pre-industrial levels, the net national decrease would be also relatively

1: The work follows the approach of the paper "Regional impact of climate change on European tourism demand", Matei et al, (2023).
2: Provinces are classified by four types of tourism: "Urban mix", "Coastal North", "Mediterranean & Islands" and "Mountains and Nature". This classification is adapted from Batista e Silva et al. (2021). "A new European regional tourism typology based on hotel location patterns and geographical criteria".
3: Economic factors, such as real GDP of destination provinces and the ratio of GDP per capita of foreign with respect to GDP per capita at destination, exhibit a positive and significant effect on bed nights, while destination prices negatively affect tourism demand.
4: Three different scenarios based on Representative Concentration Pathways (RCPs), formally adopted by the IPCC, that quantify future GHG concentrations. RCP 2.6: low future emissions trend, reaching net zero by 2100, with a temperature increase of 1.8ºC by 2100 compared to pre-industrial levels; RCP 4.5: low to moderate future emissions trend, with a temperature increase of 2.8ºC by 2100; RCP 8.5: very high future emissions tripling current levels by the end of the century, with a temperature increase of 4.8ºC by 2100. For more details see Box 1.

small (-0.6%), but provincial impacts would be already visible. In the most severe warming scenario, with an increase in temperature of almost 4.8ºC by the end of the century, the model predicts a significant reduction in overall tourism demand, with a national net decline of approximately 7% by 2100 (see **Figures 3 and 4**)[5]. Hence, it is important to note that changes in tourism demand are generally non-linear in relation to warming levels.

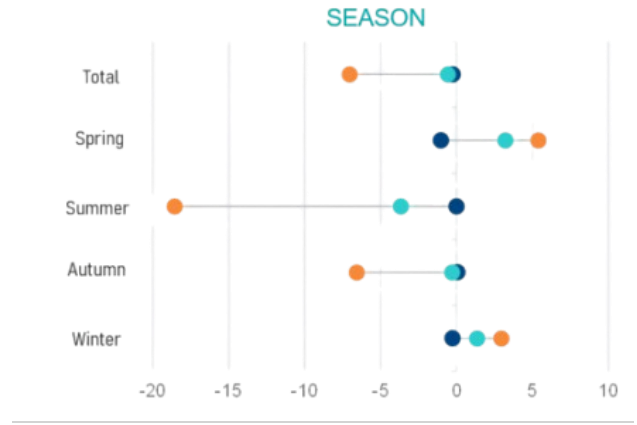
The expected effects are most pronounced in the Mediterranean and Southern coast, like the Balearic Islands, which could see summer demand drop by 60%, with a partial recovery in autumn, leading to an overall net decline of around 27%. Meanwhile, Northern provinces and nature-based destinations may benefit from this shift in demand, resulting in a general rise in tourism especially in peak-seasons. The highest increase in demand would be observed in Asturias, of almost 7%. The study also highlights the potential for deseasonalization of tourism, with spring becoming a particularly favorable season for travel.[6] As extreme summer heat discourages travel to traditional destinations, spring could become a more popular season for tourists. Moreover, this shift could help alleviate the strain on summer tourism, provided that it is supported by necessary policy measures and investment in infrastructure.

Figure 3. **NET EFFECT ON TOURISM DEMAND BY 2100 BY TYPE OF TOURISM UNDER DIFFERENT SCENARIOS** (%)



Notes: Average variation (%) of decade 2091-2100 with respect to base 2024-2030. Colors represent the different scenarios: RCP2.6 (dark blue), RCP4.5 (light blue), RCP8.5 (orange).
Source: BBVA Research.

Figure 4. **NET EFFECT ON TOURISM DEMAND BY 2100 BY SEASON UNDER DIFFERENT SCENARIOS** (%)



Notes: Average variation (%) of decade 2091-2100 with respect to base 2024-2030. Colors represent the different scenarios: RCP2.6 (dark blue), RCP4.5 (light blue), RCP8.5 (orange).
Source: BBVA Research.

The impact of climate change on tourism highly depends on temperature thresholds. While both TCI and HCI climate indices are designed to assess the suitability of a destination's climate for tourism, they have different weighting and ranking systems for climatic factors, leading to variations in the magnitude of projected impacts. For instance, under the most severe warming scenario, the HCI forecasts a national net effect on tourism demand of around −0.42%[7] (compared to −7% indicated by the TCI). Further research is required to refine these projections, particularly to establish better thresholds for different types of tourism activities. Tourists appear to adapt their preferences based on their destination, and it is important to gather more data over time, especially as temperatures continue to rise and new behavioral patterns emerge. Additionally, the implementation of more

5: Projection results compare tourism demand for the 2090s decade, defined as the period 2091–2100, against a baseline from 2024–2030. The reasons are (i) ease of interpretation, (ii) reduces the variability and uncertainty of future years, (iii) avoid biases of the Covid period.
6: In contrast, at the national level there is no compensation effect in autumn. This could be driven by the incorporation of September to this group, while it may be more similar to the patterns observed in the summer months and hence driving the negative effect.
7: This divergence stems from the HCI's lower sensitivity to extreme heat in beach destinations.

flexible school and work holidays, along with future adaptation measures, could further influence how seasonal tourism demand shifts in response to climate change.

Figure 5. **NET EFFECT ON TOURISM DEMAND UNDER AN ADVERSE CLIMATE SCENARIO. 2091-2100**
(%, USING AS BASE 2024-2030)

Notes: Conditional forecast based on TCI projections under RCP8.5, comparing the average effect of the decade 2091-2100 with respect to the base period 2024-2030.
Source: BBVA Research.

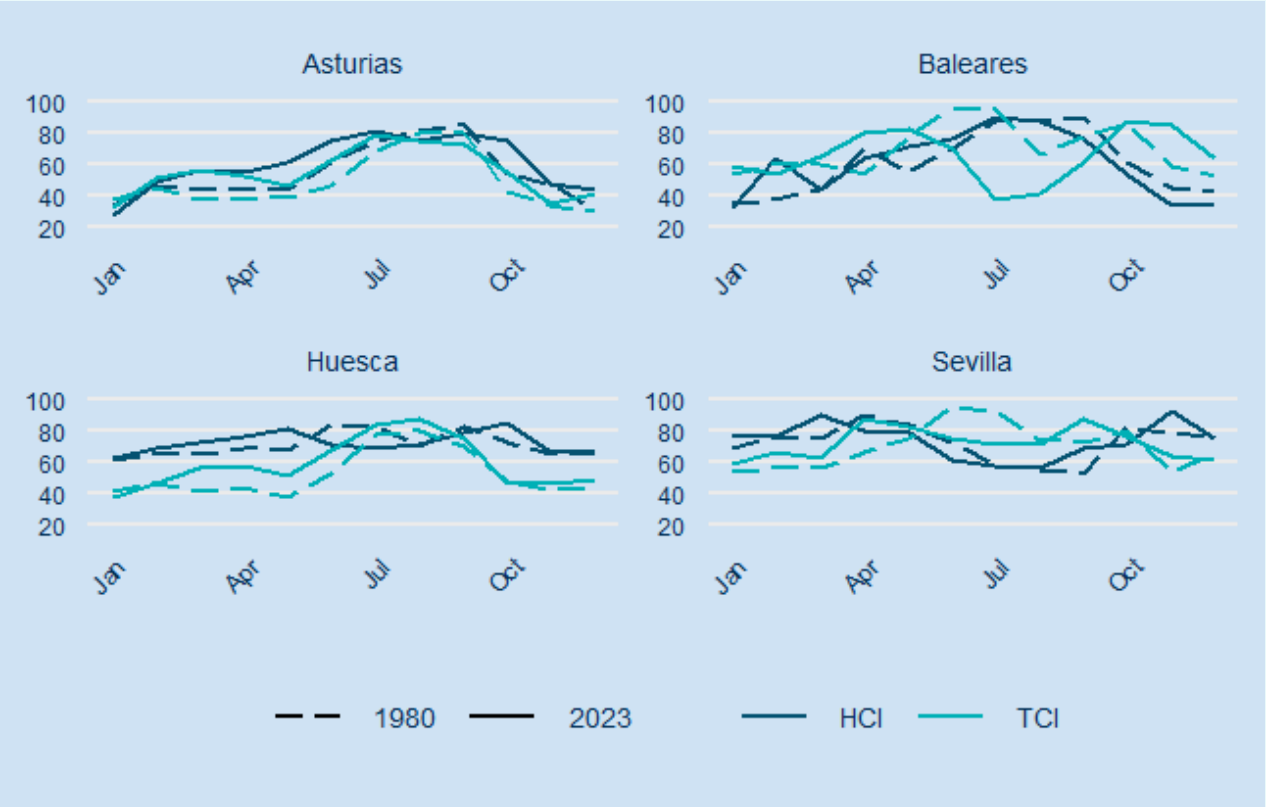
In summary, the BBVA Research's study highlights the challenges posed by climate change to Spain's tourism sector, particularly for traditional summer beach tourist areas in Southern and Mediterranean provinces. While the future overall impact is expected to be negative, the potential for deseasonalization and regional diversification also offers opportunities for economic growth. To mitigate the adverse effects, the tourist industry must adapt by promoting off-peak travel, developing sustainable infrastructure, and diversifying tourist attractions beyond beach tourism to ensure the long-term resilience of Spain's tourism sector.

Box 1. Measuring climate comfort and analyzing its impact on tourism demand against a background of climate change

A. Climate Comfort Indexes

In order to measure the impact of climate change on tourism demand, the analysis is based on two key climate indices: the **Tourism Climate Index (TCI)** and the **Holiday Climate Index (HCI)**, as these indices capture a range of factors including temperature, humidity and precipitation to assess the climatic suitability of regions for tourism activities.[8] To do so, all the climate variables are ranked according to different thresholds - with an additive methodology, in which the weights of each sub-index indicate the relative impact of each climatic component. The difference in both indices relies on the different thresholds and weights assigned to each variable. While the TCI is the most widely used measure, the HCI was designed to be specified for major tourism segments and destination types: beach and urban tourism.

Figure 6. **TCI AND HCI IN SELECTED PROVINCES(*)**



(*) Each of the provinces in the figure are representative of a type of tourism (Asturias for Coastal North, Baleares for Mediterranean and Islands, Huesca for Mountains and Nature, and Sevilla for Urban mix). HCI beach was employed for both coastal types of tourism, while HCI Urban for the remaining provinces.
Source: BBVA Research.

B. Methodology

The analysis has been developed in two phases:

1. **Historical Panel Estimation**: A panel regression model estimates how climatic factors (namely, TCI and HCI) influenced tourism demand (bednights) over the past two decades. The model is estimated on a monthly base and controls for economic factors such as GDP and prices (CPI) of the destination province,the ratio of GDP per capita of the foreign origin countries with respect to the GDP per capita at destination, as well as type of provincial tourism (Tclass), seasonal dummy variables (M) and a COVID-19 dummy. It also applies fixed effects to account for province-specific characteristics[9]. The equation is as follows:

$$ln(BN_{it}) = \gamma + \alpha_i + \beta_1 ln(TCI_{it} \times Tclass_i) + \beta_2 ln(GDP_{it}) + \beta_3 ln(CPI_{it}) + \\ + \beta_4 ln(GDPpcfor_{it}) + d_s M_S + d_c Covid + \epsilon_{it}$$

2. **Conditional Forecasting**: The second phase projects future tourism demand under three different climate change scenarios based on Representative Concentration Pathways (RCPs), formally adopted by the IPCC, that quantify future greenhouse gas concentrations and radiance forcing due to increased pollution. These forecasts provide an outlook on how tourism demand may shift by 2100 under varying degrees of global warming[10]. Namely, there are three scenarios:

- Net zero scenario (RCP 2.6): low future emissions trend, declining by 2020 and reaching net zero by 2100, with an increase of 1.8ºC by 2100 compared to pre-industrial levels.
- Intermedium scenario (RCP 4.5): low to moderate future emissions, with an increase of 2.8ºC by 2100 compared to pre-industrial levels.
- Adverse scenario (RCP 8.5): very high future emissions tripling current levels by the end of the century, with an increase of 4.8ºC by 2100 compared to pre-industrial levels.

8: The literature has long explored the effect of temperature as it offers a direct measure of climate impact (Bigano and Tol, 2005; Cai and Leung, 2010; Taylor and Ortiz, 2009; Barrios and Ibañez, 2015, Priego et al., 2015). The use of climate indexes, however, provides a more complete understanding on the effect of climate on tourism demand (Mieczkowsi, 1985; Amelung & Moreno, 2012; Daniel Scott and Göosling, 2016; Rutty et al. 2020; Ogur and Baycan, 2023; Matei et al., 2023). In addition, some works quantify the effect of natural disasters and extreme events driven by climate change (Roselló et al. 2020, Cevik and Ghazanchyan, 2021).
9: More precisely, the model was estimated using Feasible Generalized Least Squares with AR(1) autocorrelation in the residuals as well as cross-sectional correlation across panels.
10: The model assumes that the influence of climatic variables on tourism demand (the elasticity) remains stable throughout the projection period (2024–2100), with economic variables held constant at 2023 levels. The model does not account for adaptation and non-linearities to changes in climate patterns.

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