Tourism Economies and Climate Change: A Brief Review of New Data and Quantitative Approaches

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Abstract

Adopting a bio-geo-physical perspective, the present study briefly discusses the cumulative effect of weather events on tourism economies. Regional warming is herein regarded as a multidimensional process, whose economic repercussions can be systematically quantified through diverse sets of quantitative indicators. Such measures capture its variegated manifestations across spatial scales, from the regional to the local – ranging from incremental temperature increases and progressive soil aridification to the growing recurrence of droughts, the intensification of extreme meteorological events (e.g. strong winds), and the oscillation between water scarcity and abrupt surges in atmospheric humidity. The synthesis of these effects delineates the principal causal mechanisms through which climate change translates into tangible outcomes for tourism-related activities. This analytical framework is further enriched through the integration of recent statistical evidence released by official statistics estimating the monetary costs of climate change from both historical and prospective vantage points. The incorporation of such indicators within a broader interpretative scheme of local socio-economic systems

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provides a novel and methodologically robust approach to the assessment of climate-related costs across multiple spatial and temporal dimensions.

Keywords: Global warming, official statistics, economic costs, indicators, Europe.

Introduction

The profound transformations in economic structures that have unfolded over recent decades have inevitably entailed substantial shifts in social dynamics. Within this context, notions of uncertainty and risk emerge as defining features of a particularly intricate process that encompasses economic performance, demographic change, cultural development, and political action (Zuindeau, 2007). Both economic dynamics and climate change have increasingly captured the attention of scholars across environmental sciences and regional studies (Puigdefabregas and Mendizabal, 1998). Indeed, economic as well as ecological disciplines are deeply engaged in elucidating the implications of regional warming for both populations and economies, together with the ways in which societies respond to such transformations (Wilson and Juntti, 2005). Although affluent nations have experienced a significant development in recent times, it remains a matter of debate whether such growth has been acquired at the expense of environmental quality (Dinda, 2004; Stern, 2004; Galeotti, 2007). The interrelations among growth and local warming provide a knowledge base elucidating climate change (e.g., Singh and Singh, 1995; Chopra and Gulati, 1997; Barbier, 2000). Building on these premises (Knerr, 1998), the present contribution discusses approaches from an economic perspective and framed within a systemic view (Juntti and Wilson, 2004). Particular emphasis is devoted to: (i) the production processes most directly affected by global warming, (ii) the broader implications for local societies, and (iii) the potential economic responses that may be mobilized to counteract – or at the very least mitigate – the negative externalities associated with climate change (Le Houerou, 1993).

Tourism Activities and Climate Change

Tourism ranks among the world's largest and most dynamic industries, contributing substantially to gross domestic product, employment, and international trade. Yet, as the sector continues to expand, so too does its exposure to global challenges, most notably climate change – manifested in global warming and heightened vulnerability to extreme meteorological events such as intense winds and heavy rainfall. The repercussions of climate change for tourism are multifaceted, shaping both the demand for and supply of travel experiences, and have become increasingly evident across diverse destinations, from coastal resorts to mountain regions. The economic implications of these transformations are profound, extending beyond the tourism industry itself to encompass wider effects on national economies, local communities, and governance structures. Direct impacts are particularly salient in several key domains: infrastructure, seasonality, natural attractions, and health-related risks (Watkiss and Hunt, 2012). Extreme weather events – including floods, hurricanes, and droughts – impact tourism infrastructure. Coastal resorts are especially exposed, as rising seas erode beaches, damage hotels and leisure facilities, and disrupt critical transport systems such as airports, seaports, and road networks. However, the increasing frequency and severity of such events also imperil non-coastal destinations.

Furthermore, gradual shifts in climatic conditions are demonstrably altering seasonal patterns of tourism. Mountain resorts, in particular, are vulnerable to localized warming, which reduces the viability of winter sports and shortens peak tourism seasons. Such changes are expected to diminish visitor flows during traditional high-demand periods, compelling businesses either to adapt or face closure. In addition, rising temperatures and shifting precipitation regimes may facilitate the spread of infectious diseases in regions previously regarded as low-risk (e.g., Zelinka et al., 2020). These health-related risks not only jeopardize the safety of tourists but also reshape destination preferences, as travelers may opt for areas with lower perceived health threats. Beyond these direct consequences, climate change exerts broader, indirect economic pressures on the tourism sector. These include shifts in consumer behavior, the redistribution of expenditure across destinations, and heightened demands on public resources. Collectively, such dynamics underscore the urgent need for adaptive strategies capable of sustaining the sector's long-term resilience.

The Economics of Global Change

Investigating trends in economic losses across Europe – widely recognized as a hotspot of global warming – presents particular challenges, largely due to the pronounced variability of both climatic regimes and production systems. In response to this complexity, the European Environment Agency (EEA) and Eurostat have established a standardized procedure for generating official statistics that estimate the monetary damage of atmospheric events at the NUTS-0 (country) level. These events are classified, in accordance with the International Council for Science (ICSU), into meteorological phenomena (e.g., storms, avalanches), hydrological phenomena (e.g., floods, landslides), and other phenomena (e.g., heatwaves, cold spells, droughts, wildfires). The underlying dataset, provided by CATDAT of RiskLayer under institutional agreement with the EEA, has been adjusted for inflation and expressed in constant 2022 prices. Data are available on an annual basis for the period 1980–2023, and include moving thirty-year averages beginning in 2009 (EEA, 2024). This use of thirty-year averages conforms to the World Meteorological Organization (WMO) definition of a climatological 'normal' period.

Average figures derived from this approach help to identify long-term trends while excluding the substantial short-term variability attributable to natural climatic fluctuations. The values, reported in both millions of Euros and per-capita terms (constant 2022 prices), are disaggregated into three categories: (i) meteorological events, (ii) hydrological events, and (iii) climatological events. After normalizing for the economic scale exposed to climate- and weather-related hazards, the evidence indicates that, between the late 2000s and the early 2020s, the European Union's mean GDP growth rate was approximately one-half of the corresponding growth rate in recorded losses. Estimates derived from World Bank data and related indicators suggest that, while part of the upward trend in damages can be explained by increasing economic value and exposure, aggregate climate- and weather-induced losses have expanded at roughly twice the pace of GDP (EEA, 2022).

Official Statistics and Indicators

Statistical analyses indicate a clear upward trend in economic losses attributable to climate change, with the last three years ranking among the five years with the highest annual losses on record. A reduction in associated economic losses by 2030 appears unlikely. A concise descriptive assessment of the dataset reveals estimated economic damages of approximately 738 billion Euros (2023 prices) across the European Union (Table 1). Notably, over 162 billion Euros – equivalent to 22% of the total – occurred between 2021 and 2023 alone. Breaking down the losses by hazard type, hydrological events, primarily floods, account for 44% of the total, while meteorological events, including storms, lightning, and hail, contribute nearly 29%. Within

Table 1 Estimates of monetary damages between 1980 and 2023 by European country considering extreme events of climate

Country	Total losses (Million EURO)	Loss per sq.km (EURO)	Losses per capita (EURO)	Insured losses (Million EURO)	Insured losses (%)	Fatalities
Austria	14726	175564	1806	2786	19	771
Belgium	16988	553942	1612	6679	39	4693
Bulgaria	5168	46564	650	93	2	265
Croatia	4154	73402	943	101	2	910
Cyprus	441	47626	618	8	2	68
Czechia	18533	234974	1783	2168	12	716
Denmark	8751	203867	1618	5443	62	533
Estonia	332	7333	236	51	15	5
Finland	2380	7034	457	73	3	7
France	129897	203449	2092	46052	35	50461
Germany	180372	504438	2225	54759	30	104544
Greece	16350	124155	1548	849	5	4690
Hungary	10444	112291	1026	587	6	874
Ireland	3955	56542	965	541	14	68
Italy	133934	443373	2311	5916	4	21822
Latvia	1250	19348	544	71	6	88
Lithuania	2283	34976	690	58	3	103
Luxembourg	1262	486143	2694	627	50	170
Malta	51	162361	128	2	4	5
Netherlands	10970	293491	688	4297	39	3918
Poland	20630	66138	545	1379	7	2553
Portugal	16671	180755	1628	578	3	10339
Romania	19628	82335	916	199	1	1445
Slovakia	1956	39893	367	84	4	121
Slovenia	17484	862448	8693	271	2	321
Spain	95966	189662	2258	5243	5	32053
Sweden	3703	8276	406	957	26	44
EU-27	738280			139872		241587

Source: Data retrieved and reorganized from European Environment Agency (EEA).

the category of climatological extremes, heatwaves represent the dominant source of human and economic impacts, accounting for nearly 19% of overall monetary losses and an overwhelming 95% of recorded fatalities, while droughts, wildfires, and cold spells jointly contribute the remaining share (EEA, 2008). Losses are also highly concentrated: a small fraction of events drives huge damages, with 5% of occurrences responsible for approximately 61% of aggregate losses and the most extreme 1% alone generating 28%.

In contrast, the majority of minor events – roughly two-thirds of all recorded cases – produce only about 5% of total losses, as derived from the underlying dataset. The pronounced inter-annual variability in loss outcomes can be explained by a combination of structural drivers, including the expansion of exposed assets in risk-prone areas, temporal inconsistencies in disaster reporting, and the anthropogenically driven rise in critical conditions on a global scale (EEA, 2012).

When expressed in constant 2023 Euros, mean annual economic losses exhibit a persistent upward trajectory across recent decades. Analysis of 30-year moving averages confirms the monotonic escalation of losses, with a fitted linear trend indicating a 53% increase between 2009 and 2023, equivalent to an approximate annualized growth rate of 2.9%. Losses are further characterized by the dominance of a few extreme years: 2021, 2022, 2002, 2023 and 1999 represent the five costliest years in the record. Although significant losses are evident throughout the entire time series, the economic impact of climate-related extremes exhibits marked spatial variability across the European Union. In absolute terms, the highest cumulative losses from 1980 to 2023 were observed in Germany, Italy, and France. When expressed on a per-capita basis, the greatest losses occurred in Slovenia, Luxembourg, and, to a lesser extent, Italy. Unfortunately, insurance penetration remains limited, with official statistics indicating that less than 20% of aggregate

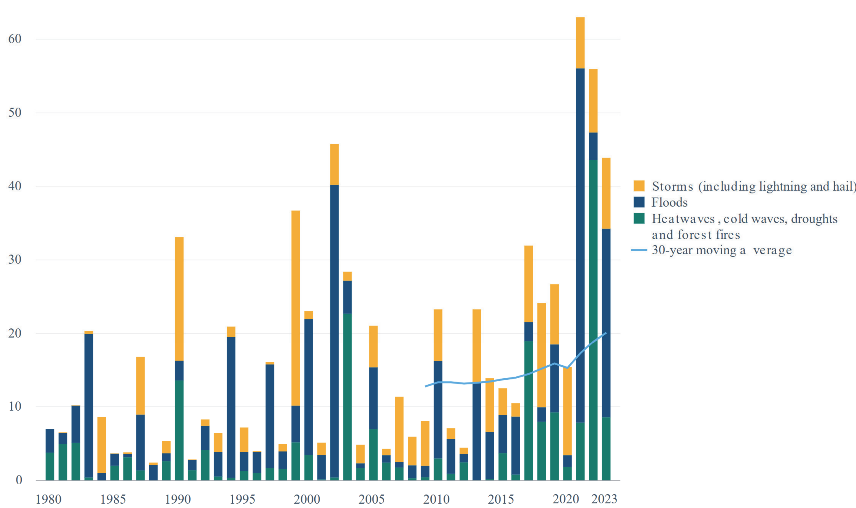

Figure 1 Annual estimate of monetary damage of extreme events in Europe (Billion Euros 2023 prices); *Source*: European Environment Agency.

losses were compensated by private insurance mechanisms. Cross-country heterogeneity is also pronounced, but only (approximately) one-third of losses attributable to meteorological events were insured, whereas the corresponding figures decline to below 15% for hydrological hazards and to just above 10% for climatological extremes – including heatwaves, droughts, and wildfires (EEA, 2020).

Discussion

This note delineates and critically reviews the effect of global warming on market dimensions in advanced countries, with a particular focus on Europe and the Mediterranean region. Variables identified as predictors of micro- and macroeconomic factors, which facilitate a comprehension of the climate and economic mechanisms harming socio-environmental systems and local communities, have been delineated and organized into key research and policy dimensions (e.g., Hausfather et al., 2022). At the microeconomic level, variables such as land and commodity prices, housing values, and wage levels – particularly, though not exclusively, within agriculture, indicate pathways through which climate change may exert influence. Moreover, technical change, fluctuations in agricultural input prices, and household income contribute to broader ecological challenges.

Macroeconomic factors – including population density, income and wealth distribution, the capacity of regional and local labor markets to absorb workforce fluctuations, poverty, and territorial disparities – have been more extensively studied using both qualitative and quantitative approaches. Nevertheless, many aspects considered critical in modeling approaches remain relatively ambiguous or partially unexplored, highlighting the need for further quantitative and comparative research. The effectiveness of policies aimed at mitigating climate impacts ultimately depends on the quality and comprehensiveness of indicator dashboards capable of estimating social and economic consequences for local communities and regional systems.

Repercussions are extensive and complex, affecting communities, industries, and economies worldwide (Salvati and Zitti, 2005). From elevated health risks to agricultural disruptions, infrastructure damage, and exacerbated economic inequalities, the consequences demand urgent scholarly and policy attention. Quantifying the economic impacts across different sectors remains particularly challenging, as each sector faces a spectrum of challenges, including rising operational costs, global supply chain disruptions, shifts in consumer preferences, and evolving regulatory frameworks, which complicate precise impact assessments (ESPON Climate, 2013). Empirical evidence indicates that individual adaptation strategies can manage residual risks not addressed by adaptation measures and to formulate strategies that enhance resilience (Daly, 1999). Effective monitoring of climate impacts is crucial for timely policy responses and the protection of vulnerable populations. By leveraging advanced technologies, including remote sensing, climate modeling, and socioeconomic data collection, it is possible to track the spatiotemporal dynamics of climate impacts, thereby enabling more informed and proactive decision-making (Kok et al., 2004).

Concluding Remarks

A rigorous examination of both direct and indirect methodologies for estimating the monetary costs associated with paradigmatic environmental processes, such as climate change, raises critical questions regarding the role of empirical data in determining the cost structure of specific interventions. Concurrently, carefully selected indirect indicators enable methodologies estimating monetary impacts, each with distinct data requirements and consequently yielding varying levels of precision in the resulting estimates. The development of improved analytical frameworks is therefore essential for designing more effective governance mechanisms that enhance public awareness of climate change costs through iterative learning and networking processes. Such frameworks also serve to optimize the capacity of existing institutional structures in environmental policy, facilitating the management of regional economic systems under the pressures of global warming.

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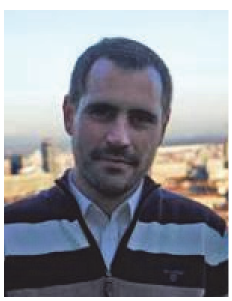

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