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The Carbon Footprint of International Tourism in the European Union

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Abstract

In recent years, international tourism has emerged as an activity with a high contribution to carbon emissions. Calculating the carbon footprint of tourism is the first step towards achieving low-carbon tourism development, mainly if it includes a detailed assessment of the carbon footprint by country of origin, destination country, and sector of economic activity. This research aims to estimate the carbon footprint of international tourism expenditure for the European Union countries. The carbon footprint calculation employs an Environmentally Extended Multi-regional Input-Output (EEIO) model. It combines the intra-regional and inter-regional transactions with data from the Tourism Satellite Accounts (TSA). The findings show that for countries with strong tourism growth, the carbon footprint of tourism is about 4% of the total carbon footprint, while it is significantly lower for other countries. Furthermore, the sectors of electricity generation, transport (water, air, and land), food products industry, accommodation, and food services contribute about 85% of the total CO_2 pollutants due to international tourism.

Keywords: Carbon Footprint, International Tourism, EU27, Input-Output Analysis

1. Introduction

The carbon footprint of tourism includes emissions from the tourism industry (sectors of transportation, accommodation, food, and recreational activities), as well as indirect emissions due to energy and water use required to operate tourism-related facilities and indirect emissions of the sectors that provide intermediate inputs to the tourism industry's value chain. For example, in the case of the operation of restaurants and other establishments that prepare and serve food and beverages, the direct carbon footprint includes emissions associated with the operation of restaurants. Furthermore, the indirect carbon footprint includes emissions from the generation of purchased electricity consumed by restaurants and the emissions that result from the restaurant's activities but are not emitted on its premises. These emissions are associated with the production, transportation, and disposal of the food, beverages, and other goods that the restaurant uses, as well as the energy and water use associated with the restaurant's operations (Rico et al., 2019).

Furthermore, a detailed assessment of the carbon footprint by country of origin, destination country, and sector of economic activity can identify the major sources of emissions and develop strategies to reduce them.

Following the definition of the GHG Protocol(2022), the carbon footprint of tourism includes direct emissions from sources that are owned or controlled by the tourism industry (Scope 1), indirect emissions from the generation of purchased electricity, steam, heating, and cooling consumed by the tourism industry (Scope 2), and all indirect emissions (Scope 3) that occur in the tourism industry's value chain (Markaki et al., 2017).

Estimating the carbon footprint of international tourism expenditure for the European Union countries can help policymakers develop effective strategies for developing low-carbon tourism. In addition, the results of this research can be used to identify the sectors and regions with the highest carbon emissions and prioritize interventions to reduce them.

We employ an Environmentally Extended multi-regional Input-Output model to estimate the carbon footprint of international tourism expenditure for the European Union countries. This EEIO model captures the environmental impacts of economic activities and products throughout their entire value chain, including upstream and downstream processes, by tracing the flows of materials and energy between regions and sectors of economic activity.(Caliendo & Schmidl, 2016; Markaki et al., 2013) Furthermore, a TSA provides a detailed account of the demand for and supply of tourism-related goods and services, including transportation, accommodation, food, retail trade and recreation, and their economic impact on the national and regional economies. Finally, using data from the TS, EEIO model can be used to estimate carbon emissions embedded in the production of goods and services that inbound tourists consume in the destination countries (Economakis et al., 2015; Markaki & Economakis, 2021; Papadakis & Markaki, 2019).

2. Methodology

This research uses the OECD's Inter-Country Input-Output Table (ICIO) for 2018, which provides the inter-country and inter-sectoral flows of intermediate and final goods and services, providing a complete account of the global value chains. The ICIO includes data for 66 countries (and all the EU27 countries) and 45 industries, covering 93% of the global GDP. In addition, a CO_2

emissions satellite account and a TSA that follows the same sector classification are also available, enabling inbound tourism to be linked to the value-added generation and CO_2 emissions in the country and abroad (Markaki et al., 2021; McKercher et al., 2010; Sun et al., 2020).

3. Results and discussion

Intra-EU tourism accounts for 1.27% of the EU27's overall carbon footprint. Figure 1 indicates that the proportion of the carbon footprint attributed to inbound tourists from European countries varies from 0.54% in Romania to 8.5% in Malta, with Greece accounting for 4.34% of the total. In Mediterranean countries with a well-developed tourism industry, inbound tourism significantly contributes to the carbon footprint. Furthermore, a substantial proportion of the tourism-related carbon footprint in EU27 countries is concentrated in those where the secondary sector is relatively small.

Figure 2 displays that the intra-European carbon footprint resulting from international tourism is primarily caused by German tourists, responsible for 30.54%. The French, Italian, Dutch, and Spanish follow closely behind, accounting for 15.04%, 6.49%, 6.40%, and 6.25% of the carbon footprint, respectively. This finding is to be expected, given that these countries have a substantial population and a comparatively high per capita income.

Table 3 displays the sector-wise breakdown of the intra-European carbon footprint caused by intra-European tourism. It reveals that a set of 13 sectors is accountable for 95% of the emissions. These sectors include "Air transport" (51), "Electricity, gas, steam and air conditioning supply" (35), "Water transport" (50), "Land transport and transport via pipelines" (49), "Coke and refined petroleum products" (19), "Agriculture, hunting, forestry" (01T02), "Food products, beverages and tobacco" (10T12), "Accommodation and food service activities" (55T56), "Other non-metallic mineral products" (23), "Chemical and chemical products" (20), "Wholesale and retail trade; repair of motor vehicles" (45T47), "Basic metals" (24), "Mining and quarrying, energy producing products" (05T06)." Table 4 reveals a crucial finding that the identified set of sectors comprises both Scope 1 (45T47, 49, 50,51, 55T56 and Scope 2 sectors (35), along with various Scope 3 sectors (01T02, 05T06, 10T12, 19, 20, 23, 24). The carbon footprint generated by the Scope 3 sectors is attributable to their robust indirect linkages with the tourism industry, as they supply the tourism industry with intermediate inputs.

Finally, Figure 4 exhibits a chord chart demonstrating the carbon dioxide emission patterns caused by tourism among European countries. Each line linking two countries represents the emissions of bilateral tourism spending from one country to the other. The length of the arc corresponding to a country indicates the amount of CO2 emissions generated within the country due to inbound tourism from other European nations.

4. Conclusion

The study has found that intra-European tourism is responsible for 1.27% of the EU27's overall carbon footprint. Inbound tourism from European countries significantly impacts the carbon footprint of Mediterranean countries with well-developed tourism industries. Most of the carbon footprint generated by intra-European tourism is due to German tourists, followed by French, Italian, Dutch, and Spanish tourists. The analysis of sector-wise carbon footprint reveals that 13 sectors are responsible for 95% of the emissions, including Scope 1 and Scope 2, along with several Scope 3 sectors.

Estimating the intra-European carbon footprint of international tourism expenditure can help policymakers develop effective strategies for developing low-carbon tourism within EU27 countries. Furthermore, the results of this research can be used to identify high-emitting sectors and countries and prioritize interventions to reduce them. Finally, the findings can also help promote sustainable tourism practices at the sector level, including using renewable energy sources in the tourism industry, which can contribute to mitigating the industry's carbon footprint.

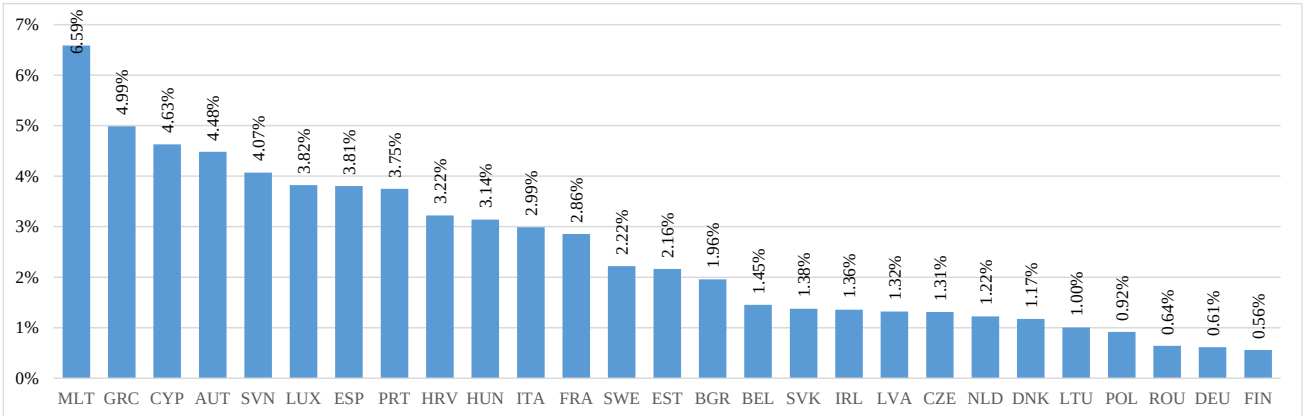

Figure 1. The ratio of inbound tourism from EU27 at the carbon footprint, EU27 countries, 2018

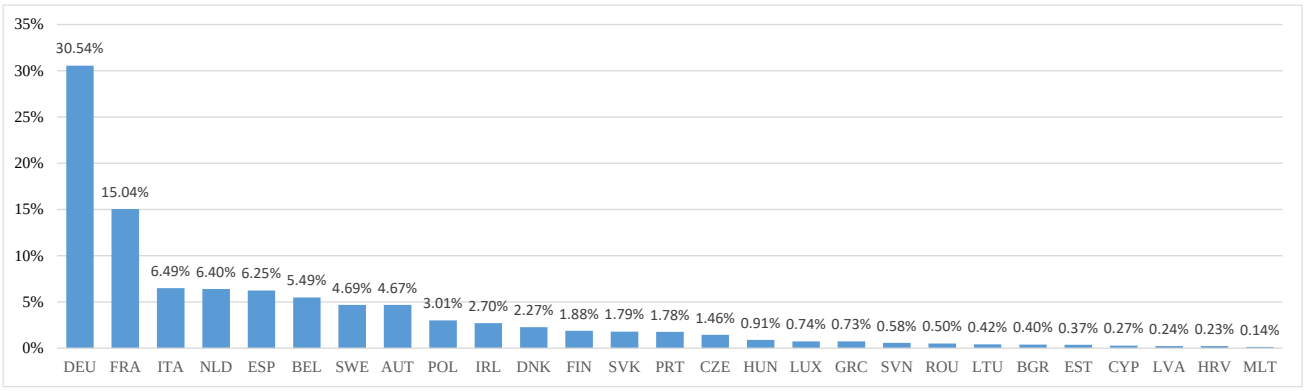

Figure 2. Intra-European carbon footprint of international tourism by country of origin, 2018

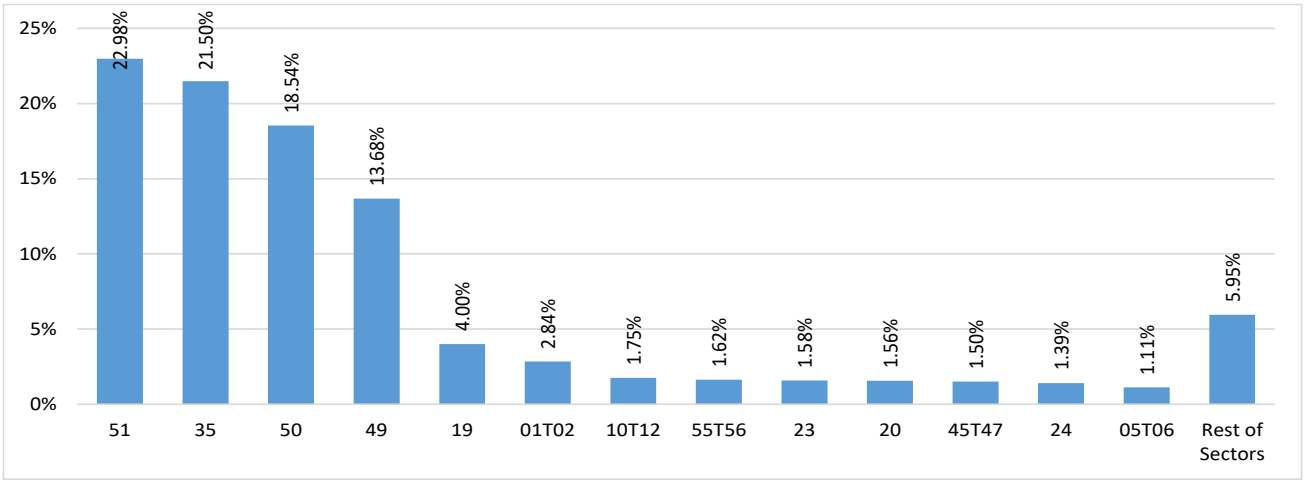

Figure 3. Sectoral structure of the Intra European carbon footprint of tourism, EU27 countries, 2018

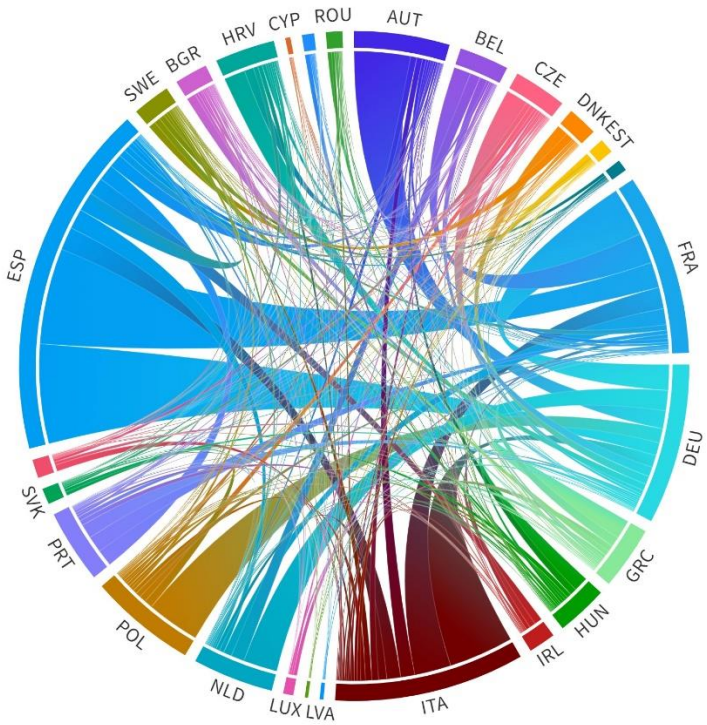

Figure 4. The carbon footprint of EU27 tourism by country of origin and destination country, 2018

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