TOURISM AND INDUSTRIAL ECOSYSTEMS. ECONOMIC RELATIONSHIPS IN EUROPE

Marco Platania
University of Catania – Catania, Italy - marco.platania@unict.it
orcid: 0000-0002-0965-8816

Giovanni Ruggieri
University of Palermo – Palermo, Italy - giovanni.ruggieri@unipa.it
orcid: 0000-0001-9085-4509

Rodolfo Baggio
Bocconi University – Milan, Italy - rodolfo.baggio@unibocconi.it
orcid: 0000-0001-9207-9665

Abstract

The European Commission deemed it necessary to update the industrial strategy to encourage the revival of European industry. As a result, The EU has adopted an ecosystem model focused on creating a productive, hyperconnected, and resilient industrial system. This study analyses the EU Industrial Ecosystems by examining the interconnections between industrial and tourism ecosystems using the social network analysis indicators. The article aims to establish the economic relationships that exist in the context of the development and investment policies the European Commission plans to implement.

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1. Introduction

Extensive research has explored tourism's contributions to economic and social development, emphasising its resilience to demand shocks (see, for example, Mazzola et al., 2019; Cochrane, 2010; Platania, 2022; Cheer & Lew, 2017; Farrell & Twining-Ward, 2004).

However, the high heterogeneity of tourism products, the diversified spatial representation of the supply, and the plurality of motivations and demand characteristics present challenges in analysing and understanding tourism as a single industry (Leiper, 1979, 2008). In recent years, the industry concept has been widely used in tourism literature, reflecting a broader perspective than the traditional theoretical notion of a sector. However, it captures only a few cross-sectoral aspects that define tourism (Higgins-Desbiolles, 2006; Davidson, 2012). While this conceptual distinction warrants further exploration, there is already a growing consensus in the literature on defining travel and tourism as an industry, linking it to broader demand, including travel and typical tourist motivations.

A comprehensive and productive framework is required to address the complexities of tourism demand. These interconnections are clearly articulated in the European Union's new industrial strategy, structured around three key drivers: a globally competitive industry, an industry leading the transition to climate neutrality, and an industry-shaping Europe's digital future (Komninos, 2022).

Industrial ecosystems (Adner & Kapoor, 2010) are central to this strategy. As outlined in the March 2020 Industrial Strategy (European Commission, 2020), this approach underscores the systemic significance of both horizontal and vertical linkages among economic actors. It also recognises the importance of activities that, while not traditionally considered part of the industry, are essential to its functioning, such as raw material supply, research, and innovation. The ecosystem perspective facilitates a bottom-up analysis of the EU economy's opportunities and challenges as it undergoes green and digital transition while enhancing its resilience.

Given the defining characteristics of European industrial ecosystems and their growing significance within European Industrial policies, further investigation into their structure and interconnections is warranted.

Moreover, to conduct a more in-depth analysis of inter-industrial relationships, particularly between tourism and other sectors, the ecosystem approach provides a more analytical and comprehensive framework than traditional sectoral or single-industry studies. The research, therefore, aims to provide a framework to compare tourism with other economic sectors and contribute to European industrial policies by offering insights into the peculiarities and common characteristics of tourism in the approach to Industrial Ecosystems promoted by the European Commission. In particular, the study aims to highlight the unique characteristics of tourism compared to other sectors and assess the implications of investment policies oriented towards the use phase versus the production phase. Furthermore, it aims to address methodological challenges, such as the limitations of static input-output models and data aggregation issues. Finally, it proposes concrete recommendations for policymakers to align tourism strategies with general industrial policies and promote cross-sectoral collaboration.

The aim of this article paper is threefold. First, in line with the European approach, the study reconstructs and analyses the tourism industrial ecosystems of the most significant tourist countries in the European Union, such as France, Germany, Spain, and Italy. Second, it examines inter-industrial transactions within tourism industrial ecosystems using a "Symmetric Input-Output Table at Basic Prices (product by product)" (NACE 63). This approach provides insights into the industrial interconnections, in terms of financial flows, that differentiate production from consumption. Finally, to identify homogeneity and differences between the tourism industrial ecosystem and other ecosystems in each analysed country, a clustering process was applied using a modularity model.

The remainder of the paper is structured as follows. Section 2 introduces the Travel and Tourism Industry Ecosystems approach. Section 3 outlines the methodology, detailing the composition of the Symmetric Input-

Output Table and the clustering process. Section 4 presents the results of the analysis, followed by concluding remarks and policy implications in the final section.

2. The Travel and Tourism Industry Ecosystems Approach

The New European Industrial Strategy (March 2020) designed a hyper-connected industrial system resilient to future shocks, human-centred, and socio-environmentally sustainable (Ghobakhloo et al., 2022).
According to the European Commission, three key drivers support this transition (Soldak, 2020):

1. Green Transition: Europe aims to become the first climate-neutral continent by 2050.
2. Global Competitiveness: Creating the necessary conditions for entrepreneurs to thrive, ensuring economic prosperity and growth for the EU.
3. Digital Transition: Enhancing the digital capabilities of economic actors, equipping them with new skills, and fostering economic (European Commission 2021b).

These transitions are guided by the Industrial Ecosystems (IE) approach, which extends beyond traditional sectoral clarifications by emphasising both vertical and horizontal linkages between all stakeholders involved. The IEs were identified through a structured methodology. The European Commission classified key activities within each ecosystem using the NACE statistical classification, applying sectoral weights to determine their relevance. Due to the interconnected nature of ecosystems, certain sectors were categorised under multiple ecosystems as horizontal sectors (European Commission, 2021a).
The 14 Industrial Ecosystems (IEs) are Aerospace and Defence, Agri-food, Construction, Cultural and Creative Industries, Digital, Electronics, Energy Intensive Industries, Energy-Renewables, Health, Mobility-Transport-Automotive, Proximity, Social Economy and Civil Security, Retail, Textiles, and Tourism. They account for approximately 70% of the EU economy and 80% of the business economy (as a share of value added) (European Commission, 2021a). The composition of the industrial tourism ecosystem is presented in Table 1, which provides an excerpt from the European Commission’s report detailing the methodology and results that defined European Industrial Ecosystems. The NACE activities in the tourism IEs are listed with their respective sectorial shares, indicating their weight in the industry-level aggregation.

Table 1 – The composition of the industrial tourism ecosystem

NACE_R2 - description	Share
H49 - Land transport and transport via pipelines	0.45
H50 - Water transport	0.22
H51 - Air transport	0.91
I55 - Accommodation	1
N79 - Travel agency, tour operator and other reservation service and related activities	1
N82 - Office administrative, office support and other business support activities	1
R90/R92 - Creative, arts and entertainment activities; Libraries, archives, museums and other cultural activities; Gambling and betting activities	0.66
R93 - Sports activities and amusement and recreation activities	1

Source: our elaboration from European Commission (2021a)

Using industrial ecosystems as a unit of analysis, this study provides new insight into tourism production and the interconnections between these ecosystems and the tourism sector within production activities (Dachs et al., 2022).

The significance of tourism Industrial Ecosystems was particularly evident in the pre-COVID era, as they were among the fastest-growing ecosystems, generating high employment growth, especially for young people, women, and low-skilled workers (European Commission 2021a).

3. Methods

Regarding the countries analysed, the top four European countries (considered 27) by number of total overnight stays in 2019, the last pre-covid year, were selected. It was decided not to display the most recent years due to a lack of data and because the effects of the pandemic crisis will only be definitively overcome in 2024 (according to the UNWTO Tourism Recovery Tracker). The countries considered are Spain, France, Germany and Italy. Germany is characterised by being the first country for domestic tourism (348 million), while the most international countries are Spain (299 million) and Italy (221 million). The four countries represent over 60% of tourism in the European Union.

To analyse the economic relations between Tourism and other IEs, we used the Eurostat symmetric tables for input-output economic exchanges, which provide a detailed picture of the supply of goods and services. Its focus on production interdependencies makes it particularly suitable for examining the relationships between the tourism industry and other sectors. Other advantages of I-O are related to its organisational capacity for data collection and visualisation, which can provide a transparent view of the structure of an economy. The disadvantages of the basic I-O model include its linearity, lack of behavioural content, lack of interdependence between price and output, lack of explicit constraints on resources and lack of possibility of substitution of inputs and imports (Rose 2004). The static nature of the model must also be considered, although this criticism is more related to the simplest form of the model and is overcome by Leontief's dynamic I-O formulation (Leontief, 1953; 1970). It must, therefore, be considered that in the model used, there is a risk of not considering changes in market supply or demand, efficiency or innovations that can influence how inputs are used over time.

Using a method applied in another study (Ruggieri e Platania, 2024), we started from the "Symmetric input-output table at basic prices (product by product)" (NACE 63) of 2018 (or the latest available) and merged the Industrial Ecosystems as defined by the European Union (European Commission, 2021a) and as previously presented to in-depth analyse inter-industrial transactions of industrial ecosystems for the top four European countries based on the ranking of nights spent (see Table 2). The intermediate matrix on which the analysis will be based is also called the intermediate flow matrix (x). It is usually square with n rows (and columns) equal to the number of sectors (or branches) into which all the productive activities of the economy are divided. The matrix shows the flows of goods and services from the sectors of origin (production sectors considered in the rows) to the destination sectors (production sectors considered in the direction of the columns) (Ruggieri & Platania, 2024).

Because of the forecast percentage weight to be considered for each NACE item and addition of multipliers ("Share") applied to specific items (see table 1), since they are "horizontal economic activities" (and therefore also of benefit to other industries), the result of the merging the NACE items does not allow a single matrix result and do not define the macroeconomic balance. However, measuring this aspect is not part of the paper's objectives. The result is, therefore, limited to the analysis of the intermediate matrix. The group process (related to the Industrial Ecosystems) leads to two different tables: the one that considers the group between branches per column, which leads to the purpose of intermediate consumption, and that which refers to the group for rows instead, which allows defining the final uses.

In analysing sectoral interdependencies, some indicators traditionally applied in matrix analyses of this type will be used (Ruggieri & Platania, 2024). A modified version of the distribution and expenditure coefficients will be calculated.

The distribution (or market) coefficient allows us to appreciate how much of the output of branch i is used in the production activity by the branch j:

$$b_{ij} = x_{ij}/x_{ni}$$

The expenditure coefficient indicates how many monetary units of asset I are needed to produce an economic unit of asset j:

$$a_{ij} = x_{ij}/x_{nj}$$

The link between the supplier and user sectors is interdependent: production levels, meaning an industry, depend not only on the final demand for its product but also on the demand for its product by the productive sectors that use it as intermediate input.

Following the reconstruction of the ecosystems, a clustering technique was applied to identify homogeneous groups based on the intensity of financial relationships.

There are various clustering techniques in the literature. In this study, we chose to use modularity measures.

Modularity is a system property that measures the degree to which densely connected compartments within a system can be decoupled into separate communities or clusters that interact more with each other than with other communities.

In a highly interconnected system with low levels of modularity, a shock to one compartment can spill over to another compartment and thus increase the risk of a collapse of the entire system. In contrast, in a system with high levels of modularity, a disturbance on one component can be better contained and less likely to spread to other components.

The advantages of this methodology can be summarised as follows:

1. Unlike other clustering methodologies, the number of clusters is found automatically.

2. The problem can be solved exactly. Many prevalent clustering problems are often solved heuristically (e.g., K-means).
3. This methodology allows for better visualisation and interpretation of the results.
4. Other methods that reduce dimensionality (e.g., principal component analysis (PCA)) allow visualisation, but interpretation may be difficult due to the change in scope.

The modularity literature describes numerous methods for measuring the modularity of a system. Furthermore, in any compartmentalised system, community structures can exist across multiple partitions, and thus, modularity can be assessed by seeking the "best solution" for the modular partitions. Despite the challenges of a precise mathematical definition, the modularity maximisation method is the most widespread in terms of use and accuracy. In this approach, the modularity of a network partition is evaluated by comparing its number of links to a null network model, i.e., an equal number of nodes, links, and degree distribution but with random links between nodes.

Many proposals for such algorithms exist (Fortunato, 2010; Fortunato & Hric, 2016; Javed et al., 2018; Souravlas et al., 2021); here, we use one of the most recent and efficient techniques, the one due to Traag et al. (2019) known as the Leiden algorithm.

Leiden is based on a previous Blondel et al. (2008) scheme known as the Louvain algorithm. This greedy approach optimises the quality function (Q) in two phases: a local moving of nodes and an aggregation of the network. Starting from a singleton partition, where each node is in its community, the nodes are moved to the community, which yields the most significant increase in Q. The aggregation phase combines the communities found as nodes in the aggregated network. Internal links of each community become weighted self-loops, and the links between nodes in different communities are represented as weighted links between the new nodes. Once this phase is concluded, the first phase of the algorithm is applied to the resulting weighted network. The two phases are iteratively repeated until there are no more changes, and maximum modularity is achieved.

The Leiden algorithm extends and improves this algorithm, which can lead to poorly connected communities by guaranteeing that all communities are well-connected. It does so by adding an intermediate phase of partition refinement. Each community is seen as a sub-network in this phase, and the phase-one algorithm is applied to those that might not have come out well-connected; some partitions could be split in this process. Leiden converges towards a network partition in which all communities' subgroups are locally optimally assigned. The aggregation is then performed by using the refined modules. The Leiden algorithm works well on practically all types of networks (unweighted, weighted, symmetric, directed, etc.), single-layer or multi-layer. It is computationally efficient and provides more reliable results (Anuar et al., 2021).

4. Results

4.1 Composing tourist industrial ecosystems through IO matrix

In composing tourist ecosystems, the data aggregation obscures regional differences. Still, we believe this limitation can be overcome, considering the need to proceed with national comparisons and the advantages linked to the synthesis capacity of the IEs model.

The first result concerns the characteristics of the tourist industrial ecosystem in the four countries examined. For the first description, we will use the employment and value-added variables (calculated considering the shares provided by the methodology of industrial ecosystems). The total number of employees in these tourism IEs varies between 3,320 in Italy and 5,074 in Germany (table 2a). The four countries represent more than 60% of the Tourism European IEs. Compared to the total number of employed people in each country, these IEs vary between 11.3% in Germany and 16.8% in Spain. In the European Union, the weight is nearly 12%. Across all countries, the top three sectors by several employees are N80-N82 (Security and investigations, services and landscape, administrative and office support activities), I (Housing) and H49 (Land transport and pipelines).

Table 2a – Employment data by industry (up to NACE A*64) (2018)

NACE_R2/GEO	Germany		Spain		France		Italy		European Union 27
	n. (thousand persons)	*Share on total EU NACE sector*	n. (thousand persons)	*Share on total EU NACE sector*	n. (thousand persons)	*Share on total EU NACE sector*	n. (thousand persons)	*Share on total EU NACE sector*	n. (thousand persons)
total Tourism IEs employment	5,073.6	*20.6*	3,329.4	*13.5*	3,332.3	*13.5*	3,320.5	*13.5*	24,645.7
Total employment (all NACE activities)	44,866.00	*21.7*	19,809.10	*9.6*	28,158.00	*13.6*	25,371.30	*12.2*	207,145.6
Share of Tourism IEs on total employment		*11.3*		*16.8*		*11.8*		*13.1*	*11.9*

* Eurostat [nama_10_a64_e]. Data refer to 2018 or the most recent year available.

In Table 2b, we also considered the gross added value. The contribution of the tourism ecosystem in the sample of countries varies between 132,209 in Spain and 190,707 in Germany, with a contribution to the total in each country ranging from 6.3% in Germany to 12.1% in Spain. In the European Union, the four countries represent almost 68% of the gross added value of tourism IEs. Considering the individual NACE sectors that constitute the tourist industrial ecosystem, in nearly all countries except Spain, the most significant added value sectors are I - Accommodation and food service activities, N80-N82 - Security and investigation, service and landscape, office administrative and support activities and H49 - Land transport and transport via pipelines. The third sector in Spain is R93 - Sports and amusement and recreation activities instead of H49.

Table 2b – Added gross Value - data by industry (up to NACE A*64) (2018)

NACE_R2/GEO	Germany		Spain		France		Italy		European Union 27
	Million euro	*Share on total EU NACE sector*	Million euro	*Share on total EU NACE sector*	Million euro	*Share on total EU NACE sector*	Million euro	*Share on total EU NACE sector*	Million Euro
total Tourism IEs v.a. gross	190,706.7	*20.9*	132,290.5	*14.5*	158,688.2	*17.4*	135,440.9	*14.8*	912,678.4
Total v.a. gross (all NACE activities)	3,032,736.00	*25.1*	1,089,420.00	*9.0*	2,101,770.00	*17.4*	1,589,576.20	*13.1*	12,094,382.4
Share of Tourism IEs on total v.a. gross	6.3		12.1		7.6		8.5		7.5

* Eurostat [nama_10_a64]. Data refer to 2018 or the most recent year available.

4.2 Clustering results

The clustering methodology has allowed industrial ecosystems to be subdivided into homogeneous groups by country of origin, consumption, and use, where homogeneity is understood in the financial flows between ecosystems (Table 3).

In the case of Italy, the grouping procedure identifies 7 groups in the production reports and 8 groups in the use reports (table 4). Considering production (inputs), tourism is grouped with cultural and creative industries, digital, retail, social economy, and civil security. Moving on to uses (output), in this country, tourism is in the cluster where Aerospace, Cultural and Creative Industries, Mobility, Retail, and Tourism are present. Another consideration concerns the common relationships between inputs and outputs: in both cases, we find clustered the ecosystems of retail, cultural industry and tourism.

Table 3 - Ecosystems analysed

	Input – cluster membership				Output – cluster membership			
Ecosys	IT	DE	ES	FR	IT	DE	ES	FR
Aerospace and Defence	1	0	0	1	0	2	0	2
AgriFood	5	5	2	2	5	1	3	4
Construction	3	4	3	5	4	0	4	3
Cultural and Creative Industries	0	3	0	0	0	0	0	0
Digital	0	3	0	0	2	0	0	0
Electronics	1	1	0	1	2	2	2	2
Energy Intensive Industries	2	2	1	3	3	3	1	1
EnergyRenew	2	2	1	3	6	2	1	6
Health	4	1	5	4	1	1	6	5
Mobility	1	6	4	1	0	4	2	2
Retail	0	0	0	0	0	1	3	1
Social Economy and Civil Security	0	0	0	0	1	0	0	0
Textile	6	1	6	4	7	1	5	1
Tourism	0	0	0	2	0	0	0	0
Modularity	0,287	0,345	0,329	0,286	0,297	0,335	0,333	0,29
Num. communities	7	7	7	6	8	5	7	7
Resol. param.	1	1	1	1	1	1	1	1

Table 4 - Relationship between Tourism and Industrial Ecosystem

Country	Tourism	
	Production	Uses
Italy	Cultural and Creative Industries Digital Retail Social Economy and Civil Security	Aerospace and Defence Cultural and Creative Industries Mobility-Transport-Automotive Retail
Germany	Aerospace and Defence Retail Social Economy and Civil Security	Construction Cultural and Creative Industries Digital Social Economy and Civil Security
Spain	Aerospace and Defence	Aerospace and Defence

	Cultural and Creative Industries Digital Electronics Retail Social Economy and Civil Security	Cultural and Creative Industries Digital Social Economy and Civil Security
France	Agrifood	Cultural and Creative Industries Digital Social Economy and Civil Security

In the production phase, the clusterisation procedure has identified 7 clusters in Germany. Tourism is in the group with Aerospace and Defence, Retail and Social Economy and Civil Security. In contrast, the output, with 5 clusters, is related to the Construction, Cultural and Creative Industries, Digital and Social Economy and Civil Security. Tourism only maintains relations with the Social Economy in the input and output phases. Germany is also characterised by having more isolated clusters in input rather than output.

In the case of Spain, it is surprising how many ecosystems are present in the tourism cluster. In production, where 7 clusters were identified, tourism is in the largest group of the four countries analysed (it contains 7 Ecosystems): tourism is grouped with Aerospace, Cultural and Creative Industries, Digital, Electronics, Retail, Social Economy and Civil Security. The cluster has a polarising role between ecosystems, leading to many isolated ecosystems. Moving on to output, where the grouping procedure has identified 7 groups, the cluster is reduced to 5 ecosystems "losing" electronic and retail but maintains a polarising position on the economic system.

Finally, regarding France, tourism in the input phase (where 6 clusters have been identified) is grouped only with agrifood (news respecting the other countries). In comparison, in the output phase (7 clusters), it is found in the group with Cultural and Creative Industries, Digital, Social Economy and Civil Security.

5. Discussion

A comparison of the four analysed countries shows common elements within the tourism industrial ecosystem. In the input phase, tourism is grouped with the social economy and retail trade in Italy, Germany, and Spain. The strong link between tourism and retail trade is well-documented in existing research (e.g. Sánchez et al., 2006; Turner & Reisinger, 2001). In this phase, these two ecosystems are strongly interconnected through financial flows. However, the connection between tourism and the social economy appears to be more a result of the methodological classification used in defining this ecosystem (European Commission (2021a) rather than an actual financial relationship. This ecosystem and corporate sectors overlap with others, such as "Accommodation and food service activities" (classified under the Tourism Ecosystem) and "Retail trade, except for motor vehicles and motorcycles" (classified under the Retail ecosystem). These sectors exhibit higher financial flows than others despite being weighted at approximately 15% in the ecosystem's calculation phase.

In contrast, France’s tourism ecosystem is closely linked to the Agri-food sector, particularly in the production phase. The financial flows between agri-food and tourists are nearly equal to those exchanged within the Agrifood sector itself. Essentially, the tourism ecosystem absorbs agrifood volumes comparable to those processed internally within the agrifood sector. The dynamics shift in the output phase (uses): tourism is strongly interconnected with the cultural industry in all four countries. Tourism in Germany, France, and Spain also activates notable links with the social economy and digital sectors.

This comparison indicates that similarities among the four countries are more pronounced in the output phase than in the input phase. From an industrial policy perspective, this suggests that investment policies targeting the output phase would likely produce more equitable economic effects compared to those favouring production. Finally, examining the ecosystems connected to tourism in both input and output phases highlights two distinct models:

1. France: The input and output ecosystems are entirely different from each other.
2. Spain: The same ecosystems involved in the output phase are also in the input phase.
3. Italy and Germany: Positioned between these two extremes, with only one ecosystem in common between their input and output faces.

The evidence from the analysis confirms the heterogeneous nature of the tourism industrial ecosystem across European countries and its complex interconnections with other economic sectors. The strong alignment in the output phase suggests that cultural industries, digital sectors, and the social economy play a crucial role in tourism's overall impact. Conversely, the variability in input phase linkages highlights differences in national production structures, which must be considered when designing targeted policy interventions.

6. Policy implications

The article's findings imply that national and EU-level industrial policies must consider structural dissimilarities between the countries so that tourism-related policies need to be more adaptive and flexible instead of rigidly standard. Based on the importance of such empirical findings, the study provides some crucial policy suggestions to enhance the tourism industrial ecosystem's resilience, sustainability, and competitiveness. One of the most critical areas for policy action is facilitating intersectoral coordination and integrated policy frameworks. Tourism does not exist in a vacuum but is strongly linked with other sectors, such as transportation, infrastructure, agriculture, energy, and digital transition.

Governments must implement cross-sectoral advisory councils that assemble tourism stakeholders, industrial policymakers, and business leaders to ensure policies are crafted to maximise synergies across sectors. This would avoid policy fragmentation and guarantee that tourism-related measures are aligned with overall industrial strategies, promoting a more integrated and coordinated approach to economic development. In addition, multi-level governance frameworks must be supported to consolidate EU, national, regional, and local policy structures so that strategies are translated effectively into various administrative levels. Targeted investment strategies that reinforce tourism's industrial linkages should constitute a second policy priority area. Smart transport infrastructure investments, including high-speed rail, multimodal transport hubs, and electric vehicle infrastructure, can improve access to tourist destinations while underpinning wider economic connectivity. Sustainable urban planning strategies should also be created to manage tourism growth in balance with the local community's needs, avoiding overcrowding and reducing environmental degradation. Furthermore, technology and digital innovation must be at the leading edge of tourism policy, with governments offering incentives for tourism operations to adopt artificial intelligence, big data analytics, and blockchain technology.

Digital tourism platforms, such as virtual reality travel experiences and AI-powered recommendation engines, are encouraging areas for investment that can strengthen demand and further incorporate tourism into the digital economy. Aside from infrastructure and technology, financing for small and medium-sized enterprises (SMEs) in the tourism industry must be a priority. SMEs are an important part of the industrial ecosystem of tourism but tend to have difficulties accessing finance and being integrated into larger supply chains. Special financial instruments, including grants, low-interest loans, and tax rebates, must be implemented to promote innovation and resilience for SMEs. In addition, policy must promote the inclusion of tourism businesses in cross-sectoral partnerships, allowing them to draw on industrial synergies and new markets. Alongside these investment approaches, securing the long-term environmental sustainability of tourism must continue to be a policy priority.

Green certification schemes and financial incentives for businesses implementing circular economy practices, like waste minimisation, renewable energy consumption, and sustainable resource use, should be introduced by policymakers. Furthermore, carbon reporting needs to be obligatory for major tour operators to stimulate the reduction of carbon footprints and conformity with the European Union's climate neutrality targets. Eco-tourism and regenerative tourism models can also support sustainability aspirations by conserving natural habitats and encouraging low-impact tourism activities. Investments in community-based and rural tourism initiatives can ensure a more equitable distribution of tourism benefits so that the local economies get higher economic returns from tourism. Lastly, this research highlights the need to enhance the resilience of tourism to external shocks, especially in the wake of recent global disruptions like the COVID-19 pandemic.

Policies need to emphasise crisis readiness and economic diversification, promoting new tourism models like health tourism, agri-tourism, and the creative economy. Workforce development also needs to be prioritised, with policies that support skills training and digital literacy programs to prepare workers for the changing needs of the tourism sector. Since tourism is a major generator of employment, especially for youth, women, and less-skilled workers, making job opportunities more inclusive will be crucial to building long-term economic resilience. In summary, the results of this research underscore the increasing complexity and importance of the role of tourism in industrial ecosystems, reaffirming the necessity for an evidence-based, cross-sectoral approach to tourism policy. The more intense interconnections during the output phase imply that demand-stimulating and consumption-investment-oriented policies will yield more sustainable and equitable economic gains.

Even considering the distinction in output use between intermediate consumption and final demand, this suggests that investment policies aimed at the consumption stage of tourism may produce more equitable and widespread benefits than strategies focused on production. This distinction is based on the nature of tourism as an industry with significant downstream linkages to other sectors, particularly in cultural activities, retail and hospitality. Policies that focus on stimulating demand, such as investments in destination marketing, heritage site development or digital tourism platforms, have a greater multiplier effect on local economies because they activate broader spending patterns across multiple sectors.

Meanwhile, the structural variations shown among the four countries examined here mean that tourism policy has to be adapted to national circumstances instead of being uniformly implemented.

Future tourism policy needs to incorporate intersectoral coordination, digital innovation, and sustainability agendas to build resilience and ensure that tourism plays a role in overall industrial development objectives. Further research is required going forward to explore how the industrial interdependencies of tourism change in the face of global trends like green transitions, digitalisation, and post-pandemic recovery strategies. This will better understand how tourism can be placed at the forefront of sustainable economic growth, generating higher resilience in both tourism-related sectors and the overall economy. By matching tourism investment with wider industrial priorities, policymakers can make the tourism ecosystem more vibrant, competitive, and sustainable for economies and societies.

7. Conclusions

The paper allowed us to analyse the characteristics of the tourism industrial ecosystem in 4 European countries using input-output analysis. Using the industrial ecosystem model proposed by the European Commission certainly has clear advantages. The methodology allows us to highlight the intersectoral connections and supply chain links that in the contemporary economy have transformed into processes of fragmentation of production structures at a physical, productive and geographical level (Rizzi and Turci, 2024).

Using percentage weights for NACE activities is certainly not new: Smith (1988) had already presented a classification of economic activities, providing ratios for each. Some studies, such as Roehl (1998) or Wilson (1998), have highlighted the problems related to the industrial classifications of tourism. A more in-depth analysis should, therefore, be made on the extent of these percentage weights, also referring to the Tourism Satellite Accounts, which would allow the coefficients to be differentiated by country.

For its implementation, subsequent analyses will also be important to verify the impact of this new approach on corporate investments (Lucarelli et al., 2023).

Moving on to input-output analysis, the limitations of studies using input-output matrices must be considered. Among the various ones, Christ (1955) states that "Input-output analysis is essentially a theory of production [...]. It does not present a theoretically complete picture of either the supply or the demand side of the economy". Consideration must be given to the limitations associated with its static nature, which could undermine industrial policies' efficiency. Despite this limit, input-output matrices still offer an important snapshot of sectoral interdependencies, useful as a basis for many analyses (Großmann & Hohmann, 2019). We can certainly affirm that analysing the inter-industrial relations between ecosystems and distinguishing the purchasing phase from the selling phase allows a more in-depth analysis of the economic processes with which the various tourist activities take shape. The relationships with some ecosystems traditionally linked to the tourist one in literature would seem to be confirmed. At the end of our analyses, the cultural industry, the digital, the transport system, retail, and agriculture are the ecosystems with more relationships (in financial terms) with tourism.

However, the paper allows two observations that, in our opinion, are very important for continuing the study of industrial interconnections. First, it is necessary to distinguish the relationships between production and consumption. Furthermore, in our paper, these relationships do not appear to be the same.

That is, the ecosystems present different interconnections if the financial flows are oriented to the input phase or the output phase. In terms of industrial policy, this means that the effects of an investment policy in favour of uses will be more equitable than one favouring production.

The second observation that the results of this paper suggest concerns the different ways of building tourism at a national level. Although some analogies are shown, the four countries show different industrial interconnections between ecosystems and tourism. A few homogeneities have been found (only in the cultural industry and the digital). These other ways of producing and consuming tourism should reflect the industrial policies the European Union will implement soon.

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