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Spillover Effects Between Urban and Non-Urban Cycling Tourism in Italy. What Is the Role of Public Transport?

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ABSTRACT

Cycling tourism gained a growing popularity in non-urban travel experiences, but the use of eventual complementary motorised vehicles may generate emissions, negatively impacting the environment. The paper, focusing on the role of public transport for intra- and inter-destination trips, has a twofold objective. First, it aims to identify the different determinants of the destination choice by bikers, considering both urban and non-urban places. Second, it investigates whether the choice of urban destinations might influence the decision of varying the frequency of cycling in non-urban places. By using primary data from an Italian survey on cycling tourism in 2020, the work outlines unobserved effects and reveals the existence of a behavioural spillover effect that is enhanced when cycling tourists use public transport. Thus, public and private investments in transport services are needed to connect urban and non-urban tourism destinations, attracting more tourists to non-urban places.

JEL Classification: C25, L92, O18, Q56, R41, Z32

1 | Introduction

Tourism is one of the most polluting sectors both locally, often overpassing the destination carrying capacity, and globally, emitting a significant amount of greenhouse gas emissions (GHGs). Besides, the continuous growth of international tourist flows with fast annual rates, except for the pandemic period, has increased the role of this industry in terms of positive economic implications, increasing its contribution to the global GDP. According to the most recent available data (Sun et al. 2024), global tourism emissions yearly grew 3.5% in the period 2009–2019, doubling the worldwide economy emissions and reaching 5.2 Gt CO_2-e, that is, 8.8% of total global GHG emissions in 2019. Consequently, in recent years cycling tourism, as the greenest form of tourism, is gaining increasing interest both by scientific literature and policymakers. Cycling, in fact, is considered one of the most important ways to make more sustainable tourism and to encourage the tourists to be conscious of their carbon footprint and environmentally responsible in their travelling choices (Derman and Keles 2023; Han et al. 2017a), including the transport means. In particular, responsible tourism puts the emphasis on what the individuals do to address sustainability in visiting tourism destinations (Goodwin 2016) and how local tourism operators and policymakers connect to a local sustainable environment in building and managing the tourism supply (Koščak and O'Rourke 2023). To consider the potential contribution of cycling tourism in the framework of sustainable and responsible tourism, growing research has been devoted to studying, on the one hand, the determinants of travel patterns and accommodation features (Pantelaki et al. 2023; Lew and McKercher 2006), and, on the other hand, the choice of transport modes in tourism experiences (Masiero and Hrankai 2022; Crotti et al. 2023; Masiero and Zoltan 2013; Pellegrini and Scagnolari 2021).

In particular, recent studies report great marketing efforts by destination managers and policymakers to increase the variety of visited attractions and to stimulate tourists' preferences

towards less explored peripheral sites (e.g., Masiero et al. 2023; Su et al. 2020). Actually, a bike tourist is considered as a slow and active tourist who visits various landscapes, interacts with residents and culture, enjoys local food, and triggers the development of attractions and infrastructure, for example, bicycle repair shops, bike hotels, and so forth (Meng and Han 2018). Yet, in terms of destinations for cycling tourism, urban and non-urban locations have been mostly studied separately, with the aim of identifying factors that could influence bike tourists' choices and preferences or analysing what infrastructural interventions might facilitate the use of bicycles in specific tourism destinations. As for urban places, on the one hand, the quality of built environments, the ability of public and private institutions to link people and places through low-impact transport networks and the possibility of cultural interactions are key ingredients of city bike tourism (Gunter and Wöber 2021; Procopiuck et al. 2020; Gehl 2010). Moreover, eco-friendly tourists using bikes have spread out also in city tourism (e.g., Banet and Kucharski 2022), with the consequence that even public transport systems have started to be planned in such a way that investments targeted to cycling tourists—for example, bike lanes, cycle stands, bike boxes and so forth—are more frequent in many urban environments (Nilsson 2019). For what concerns the development of cycling tourism in non-urban areas, since the supply of ancillary transportation services and the potential connection between places is less effective than in urban contexts, (especially by public transportation services) the sustainability issue related to tourism displays more complexities, with the consequence that cycling tourists might have less incentives to visit non-urban places (Becken 2019). In non-urban environments, indeed, attractions are often low accessible, unless tourists use private vehicles (Dickinson and Lumsdon 2010), especially when inter-destination trips are long, and cycle paths are insufficient or absent. Therefore, even if cycling tourists might have in common the intention to visit urban and/or non-urban places by reducing their own impact on local sites, one of the most pressing issues is to manage the intra- and inter-destination trips when visiting the different attractions. This will happen by reducing the use of cars and increasing also the public transport use, in conjunction with the cycles, thus promoting multimodal trips. Even though the interplay between urban and non-urban destinations and the role of public transport to connect places are of utmost importance when considering the necessity to market cycling tourism experiences in different locations (Masiero et al. 2023), the literature on bike tourism still lacks studies when the interdependence of the two types of destinations is investigated. Additionally, the use of public transport for urban and non-urban trips by cycling tourists is still scarce, especially as regards the Italian non-urban areas (see Section 2).

Within this framework and considering the above literature gap, this paper develops a multivariate model using primary data from an Italian online survey on cycling tourism conducted at the beginning of 2020 (before Covid-19 pandemic), with a double aim. First, the objective is to explore which socio-economic variables, cycle-related and infrastructural factors, and travel preferences (including accommodations) influence the frequency of visiting urban and non-urban places during cycling tourism, including the decision to use public transport combined with cycles to connect different tourism locations. Second, the aim is to identify whether there is a spillover effect between urban and non-urban cycle tourism. In particular, this paper tests whether the interplay between visiting urban and non-urban areas might display a causal link in cycling tourism experiences, that is, a spillover effect inducing cycling tourists accustomed to urban sites to spread towards non-urban areas, and the potential role of public transport to boost that effect (see Groß and Grimm 2019).

The paper is organised as follows. After the introduction, a literature review on socio-demographic and travel-related variables, mobility patterns at the destination, and the multimodal use of cycles with public transport is presented. Data and methodology are described in Section 3, while Section 4 discusses the results of the empirical analysis, enhancing the original contribution to the available literature. Finally, Section 5 draws conclusions and underlines the policy implications.

2 | Literature Review

The definition of non-urban tourism is not straightforward and can include various forms of tourism outside of the city environment, including rural tourism (see Oppermann 1996 for categories of non-urban tourism).

Related specifically to rural tourism, UN Tourism (n.d.) defines it as a type of tourism activity in which the visitor's experience is related to a wide range of products generally linked to nature-based activities, agriculture, rural lifestyle/culture, angling and sightseeing. Applying Butler's tourist area life cycle model (Butler 1980) to tourism in general, it results that non-urban tourism is experiencing a regeneration phase. On the one hand, based on marketing strategies, various destination management actions are implemented to increase the popularity of peripheral areas. On the other hand, local policies and initiatives aimed at promoting sustainable ways of travelling to rural places are more and more issued (Lane and Kastenholz 2015; Garrod et al. 2005). Breiby et al. (2020) performed research with local stakeholders to explore how tourists and residents relate to Lake Mjøsa in South-Eastern Norway. The study found that sustainable experiences include interaction with the natural environment, cultural environment, insights and views, and lake-based activities. Above all, rural tourism has been described as a high emotional experience for tourists (Jepson and Sharpley 2015). In recent years, among others, cycling tourism emerged as a niche tourism market with potential high economic growth implications for cities (Gunter and Wöber 2021). Through a GIS-based approach, Piras et al. (2024) demonstrated that after the implementation of the regional cycle network in Sardinia, various zones in the metropolitan area of Cagliari significantly increased their level of accessibility to the beaches. Besides city cycling tourism (Chen and Lee 2017), cycling might help protect the natural heritage from pollution and reduce carbon footprint from motorised means of transport (Becken 2019). It has received increasing attention from researchers, destination managers and policymakers as a type of slow tourism

endowed with intrinsic sustainable characteristics, for instance, Buning and Lamont (2021) reviewed the literature on mountain cycling tourism impacts and highlighted that there is an increasing interest from the researchers, but the body of knowledge around mountain cycling tourism is fragmented, and the authors recommend deploying bespoke data collection instruments. Gazzola et al. (2018) argue that mountain-cycling tourism is economically, socially and environmentally beneficial for non-mass tourism areas, while Mundet et al. (2022) support that road cycling tourism can contribute to a more equal distribution of tourist demand for mass-tourism areas in rural and/or urban environments. Also, attention has attracted the ability of cycling tourism to be combined with public transport services when connecting within-destination places (Han et al. 2017b) and there is an ongoing analysis of the environmental impact of tourist transport in the EU for urban and rural environments (Lumsdon 2000).

2.1 | Socio-Demographic and Travel-Related Variables

Cycling (using as an example the urban environment) has been described in the literature as a rich embodied experience with essential understanding of scenescapes (Van Duppen and Spierings 2013). Heinen et al. (2010) undertake a review of the factors associated with cycling for commuting, highlighting the difference with respect to the use of motorised means of transport. The authors categorise them in the following groups: built environment, socio-economic factors, psychological factors (attitudes, social norms and habits), cost, travel time, effort and safety. Further research has been devoted to the determinants of travel patterns and accommodation features in urban and rural environments (Pantelaki et al. 2023) or urban (Lew and McKercher 2006) and the choice of transport modes in tourism experiences in peripheral urban areas (Masiero and Hrankai 2022), city bike tourism (Crotti et al. 2023) and intra destinations (Masiero and Zoltan 2013). As regards the preferences, Vedel et al. (2017) showed that on average people state that they are willing to cycle for commuting longer if the route has a designated cycle track or green surroundings. Additionally, Nawrath et al. (2019) found that urban cyclists demonstrate persistent patterns and preferences for a green environment and value it more than infrastructural improvements. As regards target group differences, McAndrews et al. (2017) highlight that cycling is characterised as an urban activity; nevertheless, cycling in rural, small and low-density places can open the possibility for women and young people to increase their cycling levels. As participation in cycling events is more probable for those who are more active cyclists, encouraging women's involvement through social network platforms is a good strategy (Grooten and Marques 2024). Nevertheless, Tribby and Tharp (2019) found that cycling in high-density urban areas shows similar levels with very low-density rural areas when controlling for socio-demographic covariates.

2.2 | Mobility Features at Destination

Understanding mobility habits within a destination is crucial to comprehend tourists' behaviour (Masiero and Zoltan 2013; Lau and McKercher 2006). Many factors affect the variety of attractions that tourists are willing to visit within a destination, including travel-based elements (e.g., group size, length of stay, distance travelled or socio-economic characteristics) and other aspects related to the peripheral urban destination itself, such as attractions' accessibility and travel characteristics (Masiero and Hrankai 2022). In particular, the level of accessibility of public transport systems has been recognised as one of the most relevant factors to comprehend mobility patterns within tourist areas (e.g., Paulino et al. 2021). Besides urban tourism, where transport networks can easily connect different attractions (e.g., Nilsson 2019), the accessibility of public transport is particularly needed in non-urban areas, where attractions are sparse and connecting within-destination places might not be financially viable unless additional demand is achieved (Hall et al. 2017). Moreover, public transport systems tend to be inefficient in rural areas (Tomej and Liburd 2019), rural and urban areas (Le-Klähn and Hall 2015) and coastal areas (Bergantino et al. 2023), if transport demand is not expanded to achieve economies of scale in rural regions (Gronau 2017). As a consequence, in these sparsely populated areas, local mobility is almost dominated by cars in natural tourist destinations (Maggi et al. 2021), urban (Le-Klähn et al. 2014) and rural areas (Briedenhann and Wickens 2004), causing negative externalities.

2.3 | Public Transport Combined With Cycles

Despite the combination of public transport and cycles being is widely perceived in European countries as a way to decrease the environmental impact of tourism flows both in urban and non-urban areas (Petersen 2016; Hjalager 2015), studies on the use of public transport in within-destination movements by cycling tourists are still scarce. This research gap is particularly relevant in Italian non-urban areas, where many tourism resources consist of a rich natural heritage, as well as agricultural and forest systems in 'inner areas', for example, natural and protected areas (Buongiorno and Intini 2021), coastal areas (Sechi et al. 2020), natural parks (Ruocco et al. 2020) and NUTS level 3 regions (Fratesi and Perucca 2017) and where cycling tourism has gained a key role in the resurgence of remote and rural (Maltese and Zamparini 2023) as well as internal areas (Petino et al. 2021). When people travel for holidays, they are more likely to use public transport, while for professional reasons private cars are preferred (Romão and Bi 2021). Le-Klähn et al. (2014) recognise that public transport can be a part of the urban tourism destination management strategy. Research on free public transport services (buses and trains) in Germany shows the opposition of local politicians and many small accommodation providers and the support from regional and national politicians, public transport providers and public transport authorities (Gronau 2017). Target group identification, catchment areas, conditions of motorised traffic, quality of offer and market communication are among the success factors for public transport use for leisure and tourism (Gronau and Kagermeier 2007). Finally, certain factors such as age, gender, household income, car availability and frequency of bus use can influence passengers' perception about urban bus experiences (Stradling et al. 2007).

3 | Data and Methodology

This section is structured into three parts. Section 3.1 aims to present how the survey was carried out, while Section 3.2 outlines the characteristics of the sample, presenting some descriptive statistics of the collected data. Finally, Section 3.3 describes the multivariate ordered response model that has been used to answer the research questions.

3.1 | Data Collection

This study is based on a unique dataset taken from an on-line national survey conducted between January and February 2020 (before the Covid-19 pandemic) by the University of Insubria, jointly with the *Federazione Italiana Ambiente e Bicicletta* (FIAB—Italian Federation on Environment and Bicycle). The questionnaire was advertised through newsletters, open calls in web magazines and tourism-related websites. The data collection took about 20 days (including one reminder). The survey has been conducted among people living in different Italian regions and with similar familiarity with the concept and the practice of cycling tourism, that is, members of cycling associations and/or people variously acquainted with the use of cycle in leisure times. Two types of respondents were considered, that is, day-trippers (with no overnight stays) and tourists, who have spent at least one overnight stay travelling with bikes (see Aschauer et al. 2021; Crotti et al. 2023). Since the aim is to explore the interplay between urban and non-urban destinations within cycling tourism experiences, a sample selection based on overnight stays ensures that the results are not distorted by the presence of individuals who do not tend to move among destinations in cycling holidays. Therefore, by filtering the survey responses, the former category's observations were removed from the dataset amounting to 1240 responses, and 858 observations were finally used for the analysis (valid response rate: 69.2%). The survey structure includes a wide range of questions about: (1) socio-demographic features (age, gender, residence location, etc.) and frequency of cycle use for different purposes (i.e., errands, commuting, leisure time); (2) characteristics of cycling trips (groups, length of daily trips and overnight stays, expenditure per person, etc.); (3) the importance of factors related to accommodation and cycling infrastructure at destination; and (4) the preference for public transport (buses, local trains, etc.) or private motorised vehicles (e.g., cars, campers, vans, caravans, etc.) to be combined with cycles during cycling travels. Concerning the dependent variable of the study, that is, the frequency with which the respondents visit urban and non-urban places (i.e., mountain, lake, countryside) during cycling tourism experiences, the questions were the following: 'On a scale from 0 to 3, and considering the mix of destinations that you visit during a typical cycling travel, indicate the frequency of choosing: (1) cities; (2) mountains; (3) lakes; (4) countryside', where the proposed ordered score was 0/Never, 1/Seldom, 2/Often, 3/Very often. Given the purpose of the research, this question has the specific aim to piece together, for each tourist, the relative preference for destination types, and the mobility patterns chosen to enjoy landscapes and move around within a single cycling travel.

TABLE 1 | Sample characteristics (858 observations).

Socio-demographic and travel-related variables		*N*	%
Gender	Female	234	27.0
	Male	624	73.0
Age	18–35	97	11.3
	36–60	517	60.3
	Over 60	244	28.4
Region of origin	North	691	80.5
	Centre/South	167	19.5
Destinations: country	Italy	558	65.0
	Abroad	300	35.0
Use of cycle: seasonality	Mostly in warm months	346	40.3
	All the year	512	59.7
Use of cycle: commuting	< 3 times a week	569	66.3
	≥ 3 times a week	289	33.7
Use of cycle: errands	< 3 times a week	616	71.8
	≥ 3 times a week	242	28.2
Use of cycle: leisure time	< 3 times a week	724	84.4
	≥ 3 times a week	134	15.6
Travel group	≤ 2 people	184	21.0
	> 2 people	674	79.0
Type of cycle used	City cycle	291	33.9
	Other cycles	567	66.1
Daily trips by cycle (km)	≤ 60 km	432	41.7
	> 60 km	426	58.3
Transport modes (w/ cycles)	Private motorised vehicles	253	29.5
	Public transport	605	70.5
Type of accommodation	B&B	293	34.1
	Other types (hotel, rented apartments, etc.)	563	65.9
Overnight stays	< 6 nights	520	53.8
	≥ 6 nights	338	46.2
Average daily expense (per person)	< €50	222	30.4
	≥ €50	636	69.6

(Continues)

TABLE 1 | (Continued)

Cycling features at destination (0–5 Likert scale of importance)	Average	SD
Cronbach's coefficient alpha (test scale): 0.9046		
Accessibility and route quality: availability in terms of bike lanes km	3.27	1.30
Accessibility and route quality: maintenance	3.36	1.27
Accessibility and route quality: presence of cycling stalls	3.39	1.42
Accessibility and route quality: safety and control	3.78	1.26
Accessibility and route quality: dedicated traffic signs	4.02	1.20
Amenities: availability of bike-friendly accommodations	3.41	1.31
Amenities: availability of commercial services	2.77	1.37
Complementary services: availability of tourism offices and information	2.93	1.30
Complementary services: availability of cycle-related services	2.99	1.34

3.2 | Sample Characteristics

The sample characteristics of the explanatory variables are presented in Table 1. As for socio-demographic factors, 73% of participants are males. In terms of age distribution, the largest class is composed of people between 36 and 60 years old (60.3%). The majority of the respondents are from the North of Italy (80.5%) and tend to visit Italy as a destination (65%). This picture is in line with 2020 national statistics displayed in Isnart-Legambiente (2020) for which most Italian cycling tourists reside in northern regions such as Veneto, Lombardy, Emilia Romagna, Piedmont and Trentino Alto Adige, and roughly 55% of Italian cycling tourism was dominated in 2019 by regions like Trentino Alto Adige (30%), Lombardy (14%) and Veneto (10%). Moreover, 59.7% of participants use cycles all year, but most of them less than three times a week for commuting (66.3%), errands (71.8%) and leisure (84.4%). Concerning travel-related aspects, 79% of travel groups are composed of more than two people. During cycling travels, daily trips by cycle cover more than 60 km for 58.3% of individuals, while only 33.9% prefer city cycles for cycling tourism. As regards the transport means, 70.5% of respondents declare using public transport (mostly train and/or local buses) to access different places during cycling holidays. The most preferred accommodation is B&B (34.1%), as the remaining types include other tourist facilities such as hotels, room rentals, and so forth, while 53.8% of cycling tourists spend less than six nights when travelling. A total of 69.6% of participants report daily expenses (per person) amounting to more than 50 euros. To capture the cycling tourists' sensitivity to cycling conditions, in this research a set of measurement tools is developed by considering related studies on bike tourism attributes (Meng and Han 2018; Han et al. 2017a). On a Likert scale from 0 to 5, the respondents were asked to evaluate the importance of specific items concerning: routes accessibility and quality (availability of bike lanes in terms of km, maintenance, presence of cycling stalls, safety and control, dedicated traffic signs); amenities (availability of commercial services and bike-friendly accommodations) and complementary services (availability of tourism offices and information, and cycle-related services). To perform a reliability analysis of those choices in the studied sample, a standard evaluation of Cronbach's coefficient alpha was conducted to test the internal consistency of the scales. In line with the standard psychometric literature (e.g., Rossiter 2011; Nunnally and Bernstein 1994), a test scale displaying Cronbach's coefficient alpha equal to 0.9046 (i.e., exceeding the recommended threshold of 0.70) supports the choice of used items to measure the importance of tourism attributes in urban and non-urban destinations for cycling tourists. As shown in the last section of Table 1, concerning accessibility and route quality, all the attributes are considered rather important (with average scores greater than 3.0). Specifically, cycling tourists display the highest preferences for infrastructures endowed with well-run and targeted signage (4.02). As for amenities, the availability of cycle-friendly accommodations (3.41) is more important than commercial services (2.77), while, referring to complementary services, the related items display quite low importance (average scores below 3.0) in terms of availability of tourism offices and information (2.93) and cycle-related services at destination (2.99).

Given the aim of the paper, as dependent variables were used, the choice frequency of urban destinations and three different non-urban destinations: mountain, lake and countryside. As displayed in Table 2, the distribution of frequency levels for the survey participants shows that 65.6% of them choose urban destinations at various degrees of frequency. Among non-urban places, cycling tourists tend to visit (often or very often) regions with mountains (88.7%), lakes (67.4%), and countryside (54.2%). Cross analysis of dependent variables and the preference for transport modes (as reported in Table A1) shows that cycling tourists who tend to use public transport are relatively likely to visit all types of destinations with respect to those preferring private vehicles.

3.3 | Methodology

For this research, a multivariate model is estimated considering correlation effects among dependent variables (i.e., the frequency of visiting urban and non-urban places) and controlling for the impact of endogenous and exogenous variables (e.g., Bhat et al. 2017). Specifically, a multivariate ordered response model is developed (Greene and Hensher 2010; Agresti 2010), where the latent propensity is written as follows:

$$y^*_{n,i} = \beta_i x_{n,i} + \varepsilon_{n,i}, \qquad y_{n,i} = k \qquad \text{if } \mu_i^k < y^*_{n,i} < \mu_i^{k+1}$$

where n: index for individuals ($n = 1, 2, \ldots 858$); i: index for the dependent variables (i = City, Mountain, Lake, Countryside); k

TABLE 2 | Distribution of the choice frequency of different destinations (dependent variables).

	Urban (City)		Non-urban (Mountain)		Non-urban (Lake)		Non-urban (Countryside)	
Frequency levels	***N***	**%**	***N***	**%**	***N***	**%**	***N***	**%**
0/Never	295	34.4	11	1.3	51	5.9	92	10.7
1/Seldom	425	49.5	86	10.0	229	26.7	301	35.1
2/Often	125	14.6	604	70.4	500	58.3	399	46.5
3/Very often	13	1.5	157	18.3	78	9.1	66	7.7

: index for ordinal levels of dependent variables; $k \in \{0/\text{Never}, 1/\text{Seldom}, 2/\text{Often}, 3/\text{Very often}\}$; μ_i^k: lower-bound threshold for the ordinal category k of the dependent variable i; β_i: vector of coefficients (to be estimated) associated to $x_{n,i}$, that is, the vector of exogenous variables presented in Table 1 (socio-demographic, travel-related and cycling features at destination); $\varepsilon_{n,i}$: standard normal errors (assumed to be independent and identical across individuals). For the sake of notation, by recoding dependent variable indexes as follows: $a =$ City, $b =$ Mountain, $c =$ Lake and $d =$ Countryside, this multivariate modelling allows for the correlation in $\varepsilon_{n,i}$ terms across the dependent variables i for each individual n, and the vector $\varepsilon_n = (\varepsilon_{n,a}, \varepsilon_{n,b}, \varepsilon_{n,c}, \varepsilon_{n,d})$ is multivariate normally distributed with a mean vector of zeros and correlation matrix Σ, whose off-diagonal terms account for the effect of unobserved attributes (e.g., general attitudes and perceptions, lifestyle and mobility needs, etc.) that might affect the propensity of response levels for each ordered variable. The vector of parameters of the multivariate ordered probit model can be written as $\gamma = (\beta_a, \beta_b, \beta_c, \beta_d; \mu_a, \mu_b, \mu_c, \mu_d | W)$ where $\mu_i = (\mu_i^0, \mu_i^1, \mu_i^2, \mu_i^3)$, $i = a, b, c, d$, and the vector W collects the off-diagonal terms of Σ matrix. Therefore, the likelihood function for individual n is as follows:

$$L_n(\gamma) = Pr(y_{n,a} \equiv m_{n,a}; y_{n,b} \equiv m_{n,b}; y_{n,c} \equiv m_{n,c}; y_{n,d} \equiv m_{n,d})$$
$$= \int_{v_a=\mu_a^{m_{n,a}}-\beta_a x_{n,a}}^{\mu_a^{m_{n,a}+1}-\beta_a x_{n,a}} \int_{v_b=\mu_b^{m_{n,b}}-\beta_b x_{n,b}}^{\mu_b^{m_{n,b}+1}-\beta_b x_{n,b}} \int_{v_c=\mu_c^{m_{n,c}}-\beta_c x_{n,c}}^{\mu_c^{m_{n,c}+1}-\beta_c x_{n,c}} \int_{v_d=\mu_d^{m_{n,d}}-\beta_d x_{n,d}}^{\mu_d^{m_{n,d}+1}-\beta_d x_{n,d}} \phi_i(v_a, v_b, v_c, v_d | W) dv_a dv_b dv_c dv_d$$

To estimate the parameters, a *composite likelihood approach* is used (Varin et al. 2011; Bhat et al. 2010), where a pseudo-likelihood approximates the full likelihood by aggregating the likelihoods associated with pairs of observations (Joe and Lee 2009; Cox and Reid 2004). In line with Piras et al. (2021), the hypothesis underlying this paper is the presence of causal relationships between the choice frequency of urban and non-urban destinations by cycling tourists. Specifically, besides unobserved effects among the dependent variables, this research tests whether choosing urban destinations might influence the decision to increase the frequency of cycling trips to one or more non-urban places, namely mountains, lakes and countryside. Since the existence of correlation effects is not compatible with the presence, at the same time, of bidirectional endogenous (or causal) effects (Bhat 2015), this empirical modelling allows for investigating how the latent propensity for urban tourism by cycle could impact the expansion of non-urban cycling tourism. In the next section, the model results are presented, considering the possible impact of the use of within-destination public transport on this one-directional effect.

4 | Model Results and Discussion

The present section first describes the results of the econometric analysis that are then discussed in Section 4.2, according to the most important findings of the literature, highlighting the similarities and differences of the papers results with respect to the other empirical studies.

4.1 | Results

In Table 3, the estimation results of the multivariate ordered probit model are presented. The first block displays the effect of socio-demographic, travel-related variables and cycling features on the choice frequency of the four types of destinations. Whereas gender is not significant when explaining destination choices, instead older cyclists are less prone to mountain places (where the physical effort is more demanding) and they prefer lake regions. Moreover, choosing countryside areas is associated with both younger and older cohorts than the 36–60 years old baseline. As expected, visiting mountain destinations is preferred by cycling tourists living in the North of Italy with respect to those residing in southern regions, while for those travelling in foreign countries, city destinations display a higher frequency. Being acquainted with the use of bikes in ordinary life (i.e., commuting, errands) is compatible with frequently visiting lakes or countryside places, while the use of cycles in leisure time is positively associated with hilly and steeper locations. Coherently, for

TABLE 3 | Estimation of the multivariate ordered probit model.

	City		Mountain		Lake		Countryside	
Variables	**Coeff.**	***T*-stat**	**Coeff.**	***T*-stat**	**Coeff.**	***T*-stat**	**Coeff.**	***T*-stat**
Gender (base: *Male*)								
Female	—	—	—	—	—	—	—	—
Age (base: *36–60*)								
18–35	—	—	—	—	—	—	0.26	1.96
Over 60	—	—	−0.23	−2.49	0.22	2.19	0.23	2.46
Region (base: *Centre/South*)								
North	—	—	0.31	3.02	—	—	—	—
Seasonality (base: *Warm months*)								
All the year	—	—	0.17	1.96	—	—	—	—
Commuting (base: *< 3 times a week*)								
≥ 3 times a week	—	—	—	—	0.20	2.07	0.23	2.52
Errands (base: *< 3 times a week*)								
≥ 3 times a week	—	—	−0.22	−2.34	0.18	1.96	0.24	2.64
Leisure (base: *< 3 times a week*)								
≥ 3 times a week	—	—	0.32	3.44	—	—	—	—
Destination (base: *Italy*)								
Abroad	0.65	7.28	−0.25	−2.47	—	—	—	—
Travel group (base: *< 2 people*)								
≥ 2 people	—	—	—	—	—	—	0.29	3.68
Type of cycle (base: *No city cycle*)								
City cycle	0.19	2.12	−0.53	−5.62	—	—	—	—
Transport modes (w/cycles) (base: *Private modes*)								
Public transport	0.19	2.06	—	—	—	—	0.26	2.88
Daily trips by cycle (base: *≤ 60 km*)								
> 60 km	—	—	−0.14	−3.06	0.12	2.51	—	—
Accommodation (base: *No B&B*)								
B&B	0.18	2.14	—	—	—	—	—	—
Overnight stays (base: *< 6 nights*)								
≥ 6 nights	0.16	2.76	—	—	—	—	0.18	3.14
Daily expense (base: *< €50*)								
≥ €50	—	—	—	—	—	—	—	—
Availability of bike lanes in km	—	—	−0.12	−3.07	—	—	—	—
Maintenance			0.14	3.28	0.13	2.96	0.08	1.96
Presence of cycling stalls	0.09	2.15	—	—	—	—	—	—
Safety and control	—	—	—	—	—	—	—	—
Dedicated traffic signs	—	—	—	—	—	—	—	—

(Continues)

TABLE 3 | (Continued)

Variables	City		Mountain		Lake		Countryside	
	Coeff.	***T*-stat**	**Coeff.**	***T*-stat**	**Coeff.**	***T*-stat**	**Coeff.**	***T*-stat**
Availability of bike-friendly accommodations	−0.09	−1.95	—	—	—	—	—	—
Availability of commercial services			—	—	—	—	0.09	2.27
Availability of tourism offices and information	−0.10	−2.17						
Availability of cycle-related services	—	—	0.14	2.80	—	—	—	—
Thresholds parameters								
Threshold 1	−0.01	−2.04	−1.39	−5.15	−1.46	−6.03	0.34	3.41
Threshold 2	1.52	6.51	−0.30	−2.20	−0.19	−2.81	1.74	7.09
Threshold 3	2.80	10.94	1.90	7.46	1.82	7.19	3.61	13.57
Correlation terms	**City**		**Mountain**		**Lake**		**Countryside**	
City	n/a	n/a						
Mountain	—	—	n/a	n/a				
Lake	0.152	2.01	—	—	n/a	n/a		
Countryside	0.018	1.99	0.089	2.32	0.064	1.98	n/a	n/a
Endogenous effects								
City	n/a	n/a	−0.39	−2.84	—	—	0.62	4.39
City × public transport	n/a	n/a	—	—	—	—	0.18	2.04

Goodness-of-fit measures	**Joint model (w/endogenous effects)**	**Independent model (w/ out endogenous effects)**
Log-likelihood at convergence	−3186.5025	−3206.0811
Wald test	$\chi^2 = 125.95, p < 0.0001$	$\chi^2 = 126.71, p < 0.0001$
Likelihood ratio test	$\chi^2 = -2[-3206.0811 - (-3186.5025)] = 39.15, p < 0.0001$	

Note: '—' indicates coefficients not statistically significant; 'n/a' denotes not applicable estimates.

what concerns the type of bikes used, city bikers likely choose urban destinations and are reluctant to mountain locations, whereas travelling every day more than 60 km by bike during cycling holidays is less (more) frequent in mountain (lake) destinations. Choosing B&Bs is positively associated with visiting cities, as well as, for longer stays (i.e., more than six nights), urban and countryside places are mostly picked. Finally, as expected, since inter-destination trips are very common in bike tourism and many cycling tourists tend to seek transport means complementary to bikes, the propensity to use public transport is positively correlated to the frequency of visiting cities or countryside places.

Interesting insights come also from the importance given to bike tourism attributes at destinations. First, among items related to accessibility and route quality, the presence of cycling stalls might boost the frequency of travelling in urban areas. As for non-urban destinations, well-run maintenance of bike lanes can act as a positive factor to encourage bike travelling to mountains, lakes and countryside. Concerning amenities, the availability of bike-friendly accommodation seems not to be a relevant factor in urban areas, and a negative coefficient might suggest that this attribute is relatively more appreciated for other destinations. By contrast, in countryside travelling, the availability of commercial services (including restaurants, local products, etc.) may convey a higher utility to bike tourists, especially in particularly remote destinations. Lastly, dealing with complementary services, the availability of tourism offices and information is not relevant in urban places (where the information gathering is less difficult for bikers), while the presence of bike-related services (e.g., cycle repair places, shops for cyclists, etc.) may boost the frequency of travelling in city contexts.

The second and third part of Table 3 displays the error correlation terms of the four dependent variables and the estimates of endogenous effects between urban and non-urban destinations, as a core research question of the paper. The correlation terms related to the frequency of choosing city, lake and countryside as destinations are statistically significant, as well as those linking mountains or lakes with countryside places. This means that the developed multivariate model is almost completely appropriate in the considered sample. Besides, it is reasonable that the cycling tourists' decision to travel mountains up and down could be distinguished from that of visiting cities or lakes, even

considering unobserved factors embedded into error terms of the model. More importantly, for the purposes of this research, notice that error correlation between the frequency of visiting urban and non-urban places such as lakes and countryside is positive, suggesting that unobserved attributes increasing the propensity to city destinations is positively correlated with latent elements, which raise the willingness to travel in lake and countryside environments by cycle. Apart from other factors, similarities in terms of flatness and cycle lanes availability shared by those places might explain the result. As for the hypothesis for which the propensity to visit urban places by bike tourists can influence that of visiting non-urban ones, there are found two interesting results. First, a higher frequency of city cycling tourism has a negative influence on cycling travelling in mountain places. The second finding is explicitly related to the main research question of the paper, and it shows that a causal linkage between urban and countryside cycling tourism might exist. This means that, besides controlling for other individual aspects, the propensity to move around cities by using cycles may be channelled to improve sustainable tourism in non-urban destinations. In order to investigate the role of public transport in this alleged spill-over between urban and non-urban cycling tourism, it is finally considered the interaction of the endogenous effect (i.e., the *City* variable) with the relative preference for public transport use during cycling trips. The choice between private and public transport has no effect on the negative impact of city tourism on the propensity to mountain environments, meaning that investments on public transport modes to be combined with cycles might not be effective to reduce the substitution effect between urban and mountain cycling tourism. No endogenous effects are detected when considering lake destinations, while it is found a reinforcing impact on the positive interplay between city and countryside tourism coming from the preference for public transport. In the last block of Table 3, goodness-of-fit measures are displayed. Compared to an independent modelling where correlation terms are set to zero, the likelihood ratio test value (+39.15, $p < 0.0001$) suggests that the joint model has superior performance.

4.2 | Discussion

This paper aims at contributing to the literature on bike tourism by studying two key aspects, that is, personal and travel-related characteristics that can affect the choice of urban and/or non-urban destinations and whether those choices might be interrelated. From the former perspective, in line with recent studies dealing with the diffusion of cycling tourism for sustainability growth and tourists' utility (e.g., Han et al. 2017b), it is first found that, in general, non-urban destinations might be more attractive due to milder trips for seniors' ability and/or fascinating landscapes for younger generations travelling in groups (see also Gazzola et al. 2018; Maggi et al. 2021). When considering the relationship between non-tourism activities (e.g., commuting, errands) and destination choices, being acquainted with an almost daily use of cycles is correlated with flatter destinations, even though city landscapes during holidays are reasonably not sought by cycle commuters used to congested urban streets, as already stressed in other European case studies (e.g., Vedel et al. 2017; Van Duppen and Spierings 2013; Heinen et al. 2010). Concerning the relevance of cycling features at destinations, in line with Nawrath et al. (2019), urban bike tourism seems not to be ready to meet bike-related needs yet, especially in terms of accommodations equipped for cyclists' needs or with tourism offices to give information about cycle itineraries and tours in the region. For what concerns multimodality choices in urban contexts, the finding is in line with the literature stating that the variety of public transport services tends to foster tourism in city areas (e.g., Le-Klähn and Hall 2015; Maltese and Zamparini 2023). Yet, since many studies on non-urban areas stressed the dominance of private motorised vehicles due to the lack of public transport services (e.g., Reilly et al. 2010; Dickinson and Robbins 2007), the positive linkage between the preference for public transport and a more intense tourism activity in countryside destinations that it is found in the sample puts forward the idea that non-urban places might be attractive also for people familiar with public transport. This finding would also imply that, besides trying to protect urban areas from pollution (e.g., Chen and Lee 2017), cycling tourists may share environmental purposes in non-urban destinations as well (e.g., Romão and Bi 2021; Gössling 2010; Peeters and Dubois 2010). More, as argued in Lumsdon (2006), using public transport in non-urban areas would allow even cycling tourists to avoid the hassle of parking constraints (especially for caravans and campers) and to not drive in unfamiliar places. However, it is well known that the supply of adequate public services in non-urban tourism destinations could be a problem, both in terms of competition with private services (Gronau and Kagermeier 2007) and of financial viability if a sufficient level of demand is not achieved (e.g., Briedenhann and Wickens 2004).

From the latter perspective, in this research is studied the potential spill-over between urban and non-urban bike tourism. As for the negative impact of city cycling tourism on mountain areas, this result might have different motivations. Clearly, the hilliness of mountain destinations (for instance, some of them are well-known by Italian cycling tourists and particularly attractive in the alpine areas) are not fit for people used to cycling trips on level ground, as it happens for most cities. Moreover, it is worth noting that the survey data do not allow control for urban vs. non-urban cycling holidays travelled with traditional or electric cycles. This would give information about the possible ability by cyclists to bear steeper paths by using e-cycles. That aspect should be considered in further research on the topic. Lastly, other unobserved characteristics of cycling tourists, such as their sporty attitude during holidays, might determine the propensity to visit mountain destinations (see Mundet et al. 2022). Conversely, when considering the positive causal linkage between urban and countryside bike tourism, this means that, besides controlling for other individual aspects, the propensity to move around cities by using cycles may be channelled to improve sustainable tourism in non-urban destinations. This result could be discussed from a two-fold perspective. On the one hand, the promotion of non-urban cycling tourism is a key aspect from a health-oriented point of view, as non-urban environments are increasingly recognised as places of healthy behaviour, also for leisure purposes (Tribby and Tharp 2019). As a consequence, if the ability to promote non-urban destinations for cycling travellers by marketing efforts is found to be effective also on cycling tourists got used to urban contexts, then more intense investments to foster city tourism with cycles (e.g., by increasing cycle-related services, including stalls, as shown in

Table 3) might produce positive spill-over effects on the tourism demand for experiences in non-urban areas. On the other hand, since most planning and facility-based efforts are concentrated in urban areas (McAndrews et al. 2017), this behavioural effect might compensate for the objective infeasibility of heavy improvements of cycling infrastructure due to the need of preserving the natural heritage and capital to the benefit of cycling and eco-friendly tourists, especially in Italy. Similarly, it is found that the choice between private and public transport has no effect on the negative impact of city tourism on the propensity to mountain environments, meaning that investments on public transport modes to be combined with cycles might not be effective to reduce the substitution effect between urban and mountain cycling tourism. Besides, studies on non-urban places consider national parks and hilly areas where public transport services are not favoured by visitors, as the majority travel to and around the destination by car (e.g., Le-Klähn et al. 2014). Since lake tourism is viewed as a way to enjoy specific and cultural landscapes (Breiby et al. 2020; Jepson and Sharpley 2015), the absence of endogenous effects when considering lake places is not surprising, even though further analysis on that relationship would deserve future attention. Instead, the positive mediating effect of public transportation between city and countryside tourism is particularly meaningful here because it evokes two remarks. Firstly, as investments in low-impact means and mobility-as-a-service (MaaS) solutions (e.g., cycles plus trains/buses) are still limited in non-urban destinations (e.g., Le-Klähn and Hall 2015), the promotion of countryside tourism should pass through an unavoidable effort to make public transport more flexible and able to permit inter- and intra-destination movements (Mundet et al. 2022). Secondly, from an environmental perspective, cycling tourists sharing the propensity to preserve natural habitats and ecological heritage during own travels (also by means of the usage of low-impact vehicles like trains or buses) might be successfully channelled from urban to non-urban contexts (Han et al. 2017b). Moreover, since the most important attraction of the countryside as a destination lies in the so-called 'sense of non-urbanity' (e.g., Horton 2008), this result implies that cycling tourists sensitive to environmental issues within urban contexts might be attracted towards the countryside. This is reinforced by the fact that public transport allows to enjoy the landscape (Stradling et al. 2007) and also by what it represents in terms of natural heritage to be preserved and protected from mass tourism through investments to improve the accessibility to non-urban areas by the use of eco-friendly multimodal transport services (Tomej and Liburd 2019; Gutiérrez and Miravet 2016).

5 | Conclusions

The development of cycling tourism in non-urban areas can be a huge opportunity to revitalise their economic and social system, which is often characterised by an aged population and low industrial opportunities. In the meantime, this form of tourism can assure sustainability, and it is consistent with the need to protect the rich natural environment, which is the most important element of these territories. The use of bikes in holiday travels makes tourists environmentally responsible and incentivises local tourist companies to develop appropriate services, reducing the negative externalities. However, the sustainability of cycling tourism in non-urban areas may be threatened by the frequent use of cars, in combination with cycles, to reach these destinations and to move among different non-urban zones, considering their frequent low accessibility in terms of public transport services. Despite the importance of this topic, the literature on the use of public transport in within-destination movements by cycling tourists is still scarce, particularly as regards Italian non-urban areas. In addition, more evidence is required to investigate the interplay between urban and non-urban tourism experiences by cycling tourists. Filling in this gap, the present paper estimates multivariate regression models to test whether the choice of urban destinations might influence the decision of increasing (or decreasing) the frequency of cycle trips to different types of non-urban places: mountains, lakes and countryside.

From a theoretical and empirical point of view, the most important contribution of the paper regards the identification of the existence in tourism of behavioural spillovers from urban areas to non-urban areas. The regression findings outline that some latent variables affecting the propensity to choose urban destinations are positively correlated with unobserved elements that increase the willingness to visit non-urban areas by cycle, especially lake and countryside environments. Vice versa, the impact is negative, referring to the choice of travel to mountains. Consequently, the propensity to use cycles to visit cities may be channelled to improve sustainable tourism in non-urban destinations. This effect is enhanced when cycling tourists use public transport for within-destination trips.

As regards the policy and practical implications, the paper's findings empirically confirm the importance of creating the conditions for tourists to choose responsibly sustainable transport means both in urban and non-urban areas. This implies huge investments by public authorities and private transport operators in green infrastructure and transport services to connect different tourism destinations and to attract more tourists in a sustainable way. Moreover, the promotion of marketing actions to stimulate the cycling tourism in city destinations can create a positive spillover effect in increasing the flows of cycling tourists in countryside destinations. Effective solutions to promote the use of low-emission vehicles by tourists are urgent, since they can help protect the environment from car-driven pollution and reduce environmental carbon footprint (e.g., Becken 2019; Chen and Lee 2017). These solutions can include the development of mobility-as-a-service (MaaS) systems, integrating cycles with trains/buses services, the offer to bikers of discount rates for use of public transport, and the provision of safe and convenient spaces for sheltering the bicycle while travelling on the train or on the bus. The destination management, indeed, greatly influences forms of tourism, tourism demand, and its impact on the environment and on the local community.

5.1 | Limitations and Future Directions

This work is not without its own limitations, and it could be improved in different directions. First, the analysis regards only the Italian context, but for a broader contribution to the bike tourism literature and to make some useful comparisons, further studies in other European or extra-European countries could be useful. Different and heterogeneous cultural and

geographical features can affect the spillover effect that emerges from the findings. Considering simultaneously different countries can also help in identifying how the local destination management practices to make sustainable and responsible tourism can affect the tourists' choice about all the transport means they need. Second, the used survey does not include any questions about sustainable habits in general, such as daily behaviours related to food and nutrition, waste disposal, car ownership and ethics issues. Further research efforts in this direction could provide a wider perspective on bikers' attitude towards the environmental and climate change problems. Third, even if there are incorporated in the analysis as many variables as possible to capture the cycling behaviour, other factors could be relevant in influencing the travel choices, such as the unavailability of good public transport infrastructure and services or excessive travel distances to be covered in trips. These or other variables could be included in further research to enrich the analysis. Finally, more diversified channels to spread out the questionnaire could be tested: the predominant use of bikers' associations to disseminate the questionnaire may partially alter some findings, and the online survey risks excluding less technology familiar and aged people. Extension of the data collection from other channels could reinforce the findings or identify any differences.

Author Contributions

Daniele Crotti: conceptualization, investigation, methodology, formal analysis, writing – original draft, writing – review and editing. **Evangelia Pantelaki:** investigation, data curation, writing – original draft, writing – review and editing. **Elena Maggi:** investigation, writing – original draft, writing – review and editing.

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Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Appendix A

TABLE A1 | Cross-analysis of dependent variables and multimodality choice.

a—Choice frequency of urban destinations (city)

	0/Never		1/Seldom		2/Often		3/Very often	
	N	%	*N*	%	*N*	%	*N*	%
Private motorised vehicles	101	39.9	127	50.2	23	9.1	2	0.8
Public transport	194	32.1	298	49.2	102	16.9	11	1.8

b—Choice frequency of non-urban destinations (mountain)

	0/Never		1/Seldom		2/Often		3/Very often	
	N	%	*N*	%	*N*	%	*N*	%
Private motorised vehicles	18	7.1	66	26.1	149	58.9	20	7.9
Public transport	33	5.5	163	26.9	351	58.0	58	9.6

c—Choice frequency of non-urban destinations (lake)

	0/Never		1/Seldom		2/Often		3/Very often	
	N	%	*N*	%	*N*	%	*N*	%
Private motorised vehicles	4	1.6	27	10.7	188	74.3	34	13.4
Public transport	7	1.2	59	9.8	416	68.8	123	20.2

d—Choice frequency of non-urban destinations (countryside)

	0/Never		1/Seldom		2/Often		3/Very often	
	N	%	*N*	%	*N*	%	*N*	%
Private motorised vehicles	40	15.8	106	41.9	96	37.9	11	4.4
Public transport	52	8.6	195	32.2	303	50.1	55	9.1