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Summary

In the last years, sustainable travels have included bike tourists visiting cities to enjoy cultural and urban environments. Yet, when considering cycling tourists' intra-destination trips by motorized vehicles, the extent of greenhouse gas (GHG) emissions could reduce the sustainability of those tourism experiences. In this paper we study the bike tourists' choice of visiting urban places and of using greener transport means, such as public transportation. By using 858 observations from an on-line survey on bike tourism in 2020 in Italy, we develop a bivariate probit model, considering socio-demographics, bike-related factors, travel characteristics, and the evaluation of cycling and accommodation features at destination. The odds of visiting cities are positively affected by travel features, e.g., picking foreign countries, travel groups, the length of stays, the availability of commercial and bike recovery services, but also negatively by road traffic. Notably, using public transportation is more likely for longer daily trips by bike, for low-cost tourists lodging in B&Bs, and for those having a higher sensitivity to bike-related services. Since we statistically found a linkage between the two choices, from a destination management perspective, our results support the sustainability claim for policies affecting them simultaneously.

Keywords: Sustainable travels, Cycling holidays, Urban tourism, Public transportation, Bivariate probit.

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

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Abstract

In the last years, sustainable travels have included bike tourists visiting cities to enjoy cultural and urban environments. Yet, when considering cycling tourists' intra-destination trips by motorized vehicles, the extent of greenhouse gas (GHG) emissions could reduce the sustainability of those tourism experiences. In this paper we study the bike tourists' choice of visiting urban places and of using greener transport means, such as public transportation. By using 858 observations from an on-line survey on bike tourism in 2020 in Italy, we develop a bivariate probit model, considering socio-demographics, bike-related factors, travel characteristics, and the evaluation of cycling and accommodation features at destination. The odds of visiting cities are positively affected by travel features, e.g., picking foreign countries, travel groups, the length of stays, the availability of commercial and bike recovery services, but also negatively by road traffic. Notably, using public transportation is more likely for longer daily trips by bike, for low-cost tourists lodging in B&Bs, and for those having a higher sensitivity to bike-related services. Since we statistically found a linkage between the two choices, from a destination management perspective, our results support the sustainability claim for policies affecting them simultaneously.

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1. Introduction

Concerning people travelling by using various and often motorized transport means, tourism is recognized as one of the main drivers of CO_2 emissions (Kongbuamai et al., 2020; Peeters et al., 2019; Dogan et al., 2017; Hall et al., 2017). As reported in Lenzen et al. (2018), between 2009 and 2013 the tourism's global carbon footprint rose from 3.9 to 4.5 $GtCO_2e$, accounting for about 8% of global greenhouse gas (GHG) emissions. Although the Covid-19 pandemic has temporarily lessened the emissions caused by tourism flows (Le Quéré et al., 2020), the United Nations World Tourism Organization (UNWTO) and the International Transport Forum (ITF) reported that, in 2016, transport-related CO_2 emissions amounted to about 73% of all the tourism-driven GHG emissions, and the tourism sector is expected to add up to 6.5% of global GHG emissions by 2030 (UNWTO-ITF, 2019). For these reasons, transport-related sustainability issues and environmental effects of tourism are fairly being devoted a rising attention in the literature (Satta et al., 2019; Han et al., 2014). From that point of view, among the types of leisure travels, in the last years it has been recognized the relevance of city tourism. The UNWTO defines city (or urban) tourism as "*a type of tourism activity which takes place in an urban space with its inherent attributes characterized by non-agricultural based economy such as administration, manufacturing, trade and services and by being nodal points of transport*" (UNWTO, 2021). This definition is notable for two main reasons. On the one hand, because in city tourism people travel where natural landscapes and forms of rural heritage are not central, but instead where built environments, historical and cultural sites, metropolitan arts, and large-scale social interactions are key ingredients of tourism utility (Procopiuck et al., 2020). On the other hand, because the sustainability of city tourism experiences crucially depends on the

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ability of local institutions, private operators, and destination managers to connect people and places by using attracting and low-impact transport networks (Gunter & Wöber, 2021). Furthermore, since urban tourism has often outpaced the leisure sector at national levels in terms of overnight rates between 2010 and 2019 (ECM, 2019), crowds of tourists in and around historical city centres would need multimodal solutions, preferably generating low CO_2 emissions (Lenzen et al., 2018; Koens et al., 2018; Önder et al., 2017). What is more, as argued by Masiero & Zoltan (2013), the choice of transport modes should not be seen only as a motivation to visit a certain destination. Hence, still in city tourism, the two decisions might be linked in a two-way direction, implying that tourism patterns might affect the transportation mix as well.

Considering the importance of transportation within urban destinations to promote sustainable tourism, this paper contributes to the literature about city tourism by focusing on the growing relevance of cycling holidays, i.e., tourism experiences where the use of bikes is predominant, and other transport means are mostly jointly utilized with bikes to connect intra-destination places (Magris and Ross, 2018). Indeed, many scholars have pointed out that the number of pro-environmentally minded tourists using bikes has steadily increased also in city tourism (among others Nilsson, 2019; Ho et al., 2015; Horton, 2006). Specifically, in many bike-oriented countries (e.g., Germany, Denmark and the Netherlands), thanks to well-established facilities and bike lanes, cycling tourism is usually not limited to one location within a destination, as many micro-travels tend to occur inside cities (Chen & Lee, 2017; Chen et al., 2014; Masiero & Zoltan, 2013; Dickinson & Lumsdon, 2010). In case of intra-destination travels, yet sustainable cycling holidays imply that a crucial distinction lies between choosing private motorized vehicles (especially cars) or public transport means, where the latter choice is usually more likely to limit CO_2 emissions (Hall et al., 2017). Specifically, the aim of the paper is to investigate bike tourists' preferences in relation to both spending cycling holidays in urban areas and resorting to public transportation for intra-destination trips. For this purpose, two binary dependent variables are considered, where the first distinguishes between urban (or city) and non-urban (or rural) destinations, while the second separates between private and public transportation used by bike tourists during own cycling holidays. Given that a linkage between the two decisions is assumed to better explain the bikers' behaviour in city tourism, in this study we contrast two bivariate probit models. Both the models include independent variables related to socio-demographics, bike-related habits, and trip features. But one of them considers bike tourists' opinions about the importance of cycling conditions at destination (mostly related to bike lanes and the availability of services) and of specific features making accommodations bike-friendly. Such aspects tackle the extent at what the tourism utility might increase when local bodies and destination managers invest into the attractiveness of urban places from the bikers' perspective. Analogously, if the relevance of those features for cycling tourists is significantly correlated to the choice of public transportation during cycling holidays, then their inclusion in the model set-up is expected to provide a novel understanding of the drivers of sustainable city tourism.

2. Literature review

In the tourism literature, the choice of travel destinations has attracted considerable attention from different fields, such as economics, sociology, and psychology (Qiu et al., 2018; Leung & Law, 2010; Papatheodorou, 2001). Wu et al. (2011) identified the factors influencing destination choices of tourists into three groups: (1) alternative-specific factors and (2) situational factors, both related to persistent and transient attributes of destinations, respectively, and (3) individual-specific factors, linked to tourists' personal characteristics. By investigating the factors which affect the choice of visiting cities during cycling holidays, but also that influence the decision of using public transport (besides bikes) in intra-destination travels, this paper considers all those factors and aspires to contribute to two strands of literature.

The first strand relates to city (or urban) bike tourism, to be intended as a category of destinations that, first of all, entails alternative-specific and situational factors. On the one hand, e.g., Moscardo et al. (1996) pointed out that permanent tourism attractions in a destination (e.g., historical sites, museums, cultural heritage) are key factors both influencing its choice and preserving its reputation (see also Wu et al., 2011; Eymann et al., 1992). Similarly, the service quality provided (i.e., accommodation, commercial services, transport systems) was noted to influence the trips planning (Awaritefe, 2004; Siderelis & Moore, 1998). On the other hand, short-term situational elements, i.e., crowdedness (Huybers, 2003), institutional conditions (Fuchs & Reichel, 2006), and climate (Hamilton, 2004) distinguish tourists choosing urban or non-urban places. As regards individual

factors, tourism habits usually change with geographical (Kim et al., 2015), and demographical segmentations, i.e., age (Anderson & Langmeyer, 1982) and/or gender (Swarbrooke & Horner, 2003). When considering the third category identified by Wu et al. (2011) – i.e., individual-specific factors influencing the choice of tourism destinations – instead, the transport means used to travel surge as an utmost aspect, especially if bicycles are involved (Lamont, 2009). Ritchie et al. (2010, p. 411) defined bike travels as a form of *"tourism that involves watching or participating in a cycling event or participating in independent or organized cycle touring"*. In particular, the latter part of that definition confirmed that most bike tourists enjoy using the bicycle in itself and undertake cycling holidays to travel in a really active way. For this reason, early studies considered bike tourism as a *global sustainable* activity (Lamont, 2009; Horton, 2006; Lumsdon, 2000; Ritchie, 1998). Later, a formal framework started containing that perspective, and Ho et al. (2015) categorized bicycle tourism as an activity: (1) occurring away from home; (2) extended to multiple days; (3) with a non-competitive nature; (4) whose main goal is the cycling activity in itself; (5) implying active mobility; and (6) meant as a form of leisure. In this sense, a bike tourist is considered as a slow and active tourist seeing a variety of landscapes, interacting with locals and culture, enjoying local food, and stimulating the development of infrastructure, such as bike lanes, bicycle repair shops, and bike-friendly accommodation (Han et al., 2017; Dickinson & Lumsdon, 2010). In terms of type of destinations, yet most of the literature about bike tourism has focused on rural locations. Han et al. (2017) argued that rurality seems a given precondition for cycling tourism, following Lamont (2009) who defined bicycle tourism as a form of 'special interest' tourism, including sport events (see also Lamont & McKay, 2012). Despite this occurrence, Dickinson & Lumsdon (2010, p. 138) clearly stated that *"Cycle tourism is not exclusively a rural tourism phenomenon. The use of the bicycle as part of the city tourism offer is enjoying a renaissance across Europe"*. Furthermore, recent evidence suggests that cycling has an all-around impact on cities as tourism destinations by transforming built environments and slowing down urban routes (Nilsson, 2019; Gehl, 2010). In particular, as noticed in Nilsson (2019), regarding alternative-specific and/or situational factors à la Wu et al. (2011), indeed attractions and activities targeting cycling tourists have become common in many cities, like Paris (Fishman, 2016; Fremiot, 2013) or Berlin (Cramer, 2014; Nilsson, 2007). Regarding to Italy, in general, Bergantino et al. (2021) underlined that this country helped the culture of cycling to spread out, mainly thanks to its cultural heritage. Petino et al. (2021) pointed out that combining strategies involving the promotion of cultural sites and the protection of the surrounding environments by enhancing bike-related transport systems has strong beneficial effects on the sustainable development of destinations in Italy.

The second strand of literature we contribute to refers to the intra-destination use of public transportation in tourism experiences, and the claims for sustainability coming from the interaction between bikes and transit and/or trains. For instance, Weed et al. (2014) argued that cycle tourists can surely be ideal *green travellers*, but still some doubts might be raised when talking about the sustainability of cycle tourism at the destination (e.g., see Zhang et al., 2015). And most of these claims are clearly related to the choice of transport means used by bike tourists. On the one hand, the usage of bikes itself depends on the quality of cycling infrastructure. As for the bicycle as a mode of transport in tourism, even though it offers benefits for quality of life in cities, allows freedom in displacement (e.g., Jacobsen, 2003), and stimulates the local labour market (Chen & Lee, 2017), Winters et al. (2016) noted how bike-related infrastructures in urban contexts are often not compatible with cycling tourists' needs. On the other hand, the combination of bikes and other transportation plays a key role in intra-destination mobility (see Prideaux, 2000 for a general discussion on this point). Among other things, Taplin & Qiu (1997) showed that cars provide the most flexibility in time and itineraries planning, thus raising the odds of intra-destination movements (see also Tideswell & Faulkner, 1999). When considering alternative-specific or situational factors about destinations (Wu et al., 2011), yet several other factors may influence the choice of public transport within a destination. Hwang et al. (2003) noted that the geographic characteristics of a destination influence the spatial patterns of tourists, whereas transport infrastructure and the availability of public transport affect the mode choice (see Thrasher et al., 2000). From a planning perspective, Lew & McKercher (2006) identify factors influencing intra-destination patterns of tourists in relation to local transit planning and itineraries. Regarding mode choices and engagement, a more intense social life and connections when travelling has been found by Koo et al. (2012) to be correlated with the use of local transit, suggesting that the activity engagement is boosted by the city public transit. Le-Klähn et al. (2014) found that public transport users tend to have longer stays at destinations than non-users. As for individual-specific factors, Hyde (2008) found that ageing is positively correlated with using private cars in tourism, also in urban areas. Van Middlekoop et al. (2003) showed that tourists travelling in a large group displayed a higher probability to

use transport modes alternative to cars, while Kelly et al. (2007) found that the probability that tourists use private motorized modes decreases for increasing fuel cost. In general, Hergesell & Dickinger (2013) pointed out that monetary costs are key factors on transport mode choice, followed by the time budget. As regards the importance of information about destinations which tourists collect before travelling, Li et al. (2008) found that they tend to make important decisions, such as accommodation and transport in advance. By looking for info in advance, tourists would be more informed about available transport options too, especially those that are sustainable and attractive to bike tourists (Guiver & Stanford, 2014). In addition, Le-Klähn et al. (2014) noted that, in addition to collecting info, tourists may also commit to specific travel modes (e.g., buying public transport tickets before departure, etc.).

3. Data and methodology

This study takes the steps from the above literature and the findings herein, aiming to further investigate the linkage between city bike tourism and the choice of public transportation for intra-destination travels. For the purposes of this research, we used data taken from an on-line national survey conducted from January to February 2020 (before the Covid-19 pandemic) by the University of Insubria, jointly with the Federazione Italiana Ambiente e Bicicletta (FIAB). Bike tourists living in Italy were reached out by newsletters, open calls on web magazines and sectorial websites, and e-mails targeted to local branch of cycling associations. As a whole, 970 responses were collected. After error-checking and removing data related to unimodal tourists, that is, individuals using uniquely bikes when travelling, we finally considered 858 observations. As said, the two most relevant aspects studied in this paper referred to (i) the choice of visiting urban cities (i.e., city tourism) in cycling holidays, and (ii) the intra-destination use of public or private transport means together with bikes. Concerning the first aspect, the respondents were asked whether they prefer visiting cities or other destinations, e.g., mountain, countryside, seaside, lakes, etc. Regarding the usage of transports combined with bikes, both public (train, bus, metro, tram, etc.) and private (car, camper, vans, etc.) modes were covered by the survey. The binary variables related to that couple of choices was created as follows: $y_{i,city}$ has value 1 if the bike tourist *i* visits cities, and 0 otherwise (i.e., rural places); $y_{i,pub}$ has value 1 if the bike tourist *i* combines bikes and public transport during cycling holidays, and 0 otherwise (i.e., private motorized means). Since the aim of the study is to investigate the linkage between two decisions, estimating a bivariate probit model was selected to encompass two equations with correlated disturbances (Train, 2003). As for the related literature about that methodology, e.g., the link between regional climate in the home area and the choice of taking holidays in the origin region or abroad was studied by Eugenio-Martin and Campos-Soria (2010). With a focus on transportation mode and tourism, Masiero and Zoltan (2013) studied the relationship between travel patterns (the number of visited regions) and travel mode choice in Switzerland. A similar study entailing the choice of using public transportation and of visiting urban destinations was conducted in Munich (Germany) by Le-Klähn et al. (2015).

In our research, the bivariate probit model implies the estimation of the two following equations:

$$\begin{aligned} y^*_{i,city} &= \boldsymbol{\beta}'_{city}\boldsymbol{X}_{i,city} + \varepsilon_{i,city} \qquad \text{where } y_{i,city} = 1 \qquad \text{if } y^*_{i,city} > 0, \text{ and 0 otherwise} \\ y^*_{i,pub} &= \boldsymbol{\beta}'_{pub}\boldsymbol{X}_{i,pub} + \varepsilon_{i,pub} \qquad \text{where } y_{i,pub} = 1 \qquad \text{if } y^*_{i,pub} > 0, \text{ and 0 otherwise} \end{aligned} \tag{1}$$

where $y_{i,city}$ and $y_{i,pub}$ are the dependent (binary) variables corresponding to individual responses; $\boldsymbol{X}_{i,city}$ and $\boldsymbol{X}_{i,pub}$ are the sets of explanatory variables (with related coefficients $\boldsymbol{\beta}'_{city}$ and $\boldsymbol{\beta}'_{pub}$). The error terms, $\varepsilon_{i,city}$ and $\varepsilon_{i,pub}$, are assumed as jointly normally distributed, with zero means and unit variance on the leading diagonal of the 2x2 variance-covariance matrix. Two symmetrical off-diagonal terms (i.e., $-1 < \rho_{city;pub} < 1$) capture the error covariance between the unobserved latent binary variables, $y^*_{i,city}$ and $y^*_{i,pub}$, telling that the choices are mutually determined. In Table 1, descriptive statistics of the dependent variables are provided. In the sample, about 56% of bike tourists tend to visit cities (or urban places) rather than other destinations, i.e., countryside, mountain, lakes, etc. Notably, during cycling holidays, 71% use bikes and public transportation.

Table 1. Choice of visiting urban destinations and using public transportation. Summary statistics.

Dependent variables	N	Mean	SD	Min	Max
City tourism = $y_{i,city}$	478	.5571	.4970	0	1
Bikes and public transport = $y_{i,pub}$	605	.7051	.4563	0	1

Regarding the explanatory variables used to model tourists' choices, a set of covariates was selected according to the literature reviewed in Section 2. They address questions related to socio-demographic aspects of cycling tourists, their usage of bikes in daily life, and tourism-based elements, including the choice of visiting Italy or foreign countries, the length of trips travelled by bike, average travel expenses, etc. In this paper, since bike-related features at destination are assumed to influence tourists' choices, other covariates were retrieved from destination and accommodation items, whose importance was evaluated by respondents on a six-points Likert scale (0-5). Internal consistency tests were performed, giving robust Cronbach's coefficients alpha of 0.9046 and 0.7745, respectively, for the two sets of items.

In Table 2, summary statistics of explanatory variable are presented. As regards to socio-demographics, three age classes were considered, where sampled individuals between 36 and 60 years old are the relative majority (60.3%). Male respondents (73%) outnumber females, while the most largely represented residents are those from the Northern part of Italy (80.5%). Although this might indicate a self-selection bias in the sample, this occurrence is actually not relevant in this case, as most Italian bike tourists live in the Northern regions, such as Veneto, Lombardy, Emilia Romagna, Piedmont, Trentino Alto Adige (Isnart-Legambiente, 2020). Besides tourism experiences, about 60% use bikes all the year, with a relative stronger preference for leisure trips at least few times a week (72.6%). In the sample, bikes are also significantly used for commuting (48%) and to run errands (54%), and 34% own city bikes. As for tourism choices, 65% prefer visiting Italy. Again, this figure is in line with Isnart-Legambiente (2020), reporting that in 2019 roughly 55% of Italian bike tourism was caught by regions like Trentino Alto Adige (30%), Lombardy (14%) and Veneto (10%). Other specific aspects of cycling tourism choices deal with: the number of travel mates (79% do not travel alone), the length of daily trips by bike (58.3% ride bicycles for more than 60 km for each trip), the number of overnight stays (more than 6 nights for 46.2% of respondents), the type of accommodation (B&B and hotels account for 63.2%), and the average per-capita daily expenses (46% spend between €50 and €80, excluding accommodations).

Regarding cycling and destination features, the respondents report that, on average, the intensity of road traffic, the availability of itineraries and tours, and road signs along bike lanes have the relative highest importance (for those figures, the mean Likert scores are above 4 out of 5). Interestingly, available commercial services (2.77) and tourism offices (2.93) gain a quite low attention among sampled bike tourists, confirming some scholars' view for which destination attributes should be also considered during the bike-travelling, rather than at destination only (e.g., Han et al., 2017; Dickinson and Lumsdon, 2010). As for accommodations, their proximity to bike lanes is fairly important (average score 3.75), but still the availability of bikes recovery has the highest relevance (4.28).

The bivariate probit model in (1) is estimated by the full information maximum likelihood, giving coefficients relying on the following log-likelihood function (Cappellari and Jenkins, 2003):

$$\log L = \sum_{i=1}^{N} ln\, \mathrm{P}\left(y_{city}, y_{pub} | x_{city}, x_{pub}\right)$$

where, for the respondent i = 1,..., N, the probabilities $\mathrm{P}\left(y_{city}, y_{pub} | x_{city}, x_{pub}\right) = \Phi_2(\mu_i; \Omega)$ depend on the bivariate standard normal distribution function, with arguments: $\mu_i = \left(k_{i,city}\beta'_{city}X_{i,city}, k_{i,pub}\beta'_{pub}X_{i,pub}\right)$, with $k_{i,city} = 2y_{i,city} - 1$ and $k_{i,pub} = 2y_{i,pub} - 1$ for each i, and the variance-covariance matrix Ω with elements $\omega_{city;city} = \omega_{pub;pub} = 1$, and $\omega_{city;pub} \triangleq \omega_{pub;city} = k_{i,city}k_{i,pub}\rho_{city;pub}$.

Table 2. Summary statistics of covariates.

Explanatory variables		**N**	**%**
Age	18-35 years old	97	11.3
	36-60 years old	517	60.3
	Over 60 years old	244	28.4
Gender	Male	624	73.0
Residence area in Italy	North	691	80.5
	Centre	117	13.6
	South and Islands	50	5.9
Type of bike owned	City bike	291	33.9
	Other types (MTB, Gravel, etc.)	567	66.1
Use of bikes: seasonality	Mostly warm months	346	40.3
	All the year	512	59.7
Use of bikes: commuting	Never/Seldom	447	52.1
	Less than 3 times a week	122	14.2
	More than 3 times a week	289	33.7
Use of bikes: errands	Never/Seldom	397	46.3
	Less than 3 times a week	219	25.5
	More than 3 times a week	242	28.2
Use of bikes: leisure	Never/Seldom	235	27.4
	Less than 3 times a week	489	57.0
	More than 3 times a week	134	15.6
Destinations: country	Italy	558	65.0
	Abroad	300	35.0
Travel group	Alone	184	21.0
	One or more travel mates	674	79.0
Length of daily trips (by bike)	Less than 60 km	305	41.7
	60 km – 80 km	233	31.9
	More than 80 km	193	26.4
Type of accommodation	Bed and breakfast (B&B)	291	33.9
	Hotel	251	29.3
	Other types (camping, etc.)	316	36.8
Overnight stays	1-2 nights	140	19.2
	3-6 nights	253	34.6
	More than 6 nights	338	46.2
Average daily expense (per capita)	Less than €50	222	30.4
	€50 - €80	337	46.1
	More than €80	172	23.5
		Mean	**SD**
Importance of cycling and destination features (0 = not important at all; 5 = extremely important)	Intensity of urban road traffic	4.16	1.08
	Available itineraries and tours	4.03	1.14
	Bike lanes: dedicated traffic signs	4.02	1.20
	Bike lanes: safety	3.78	1.26
	Available accommodations	3.41	1.31
	Bike lanes: presence of bike stalls	3.39	1.42
	Bike lanes: maintenance	3.36	1.27
	Bike lanes: availability	3.27	1.30
	Available bike-related services	2.99	1.34
	Available tourism offices	2.93	1.30
	Available commercial services	2.77	1.37
Importance of accommodation features (0 = not important at all; 5 = extremely important)	Available bikes recovery	4.28	1.09
	Proximity to bike lanes	3.75	1.19
	Available breakfast service	3.53	1.41
	Available tourism support	2.76	1.45
	Available half-board service	2.61	1.59

4. Results and discussion

In order to investigate, on the one hand, the linkage between the choice of visiting urban cities and using public transports together with bikes, and, on the other hand, the alleged role of destination and accommodation features for the above choices, in this paper two bivariate probit models were estimated and compared. The first model (labelled with BP_1) considers socio-demographic variables, info about the general usage of bikes, and trip-related aspects, while in the second one (BP_2), Likert-scale bike tourists' evaluations of destination and accommodation items are added to the base specification. Estimation results are presented in Table 3. For each model, two columns collect the parameter estimates of explanatory variables on the choice of visiting cities (*City tourism*) and of using public transports with bikes (*Bikes and public transport*), respectively. The interdependence of the two choices is evaluated by the error correlation $\rho_{city;pub}$, reported for each model. Goodness-of-fit measures are also provided in the table. Specifically, we contrast two log-likelihood ratio tests: the first one statistically tests whether the model BP_1 outperforms that containing constant terms only (BP_0); the second test, for BP_2, is actually calculated against BP_1, to check if the augmented specification is better off. With the aim of answering to our first research question, notice that in Table 3 the Wald test implying the null of zero correlation between the two choices (H_0: $\rho_{city;pub} = 0$) is reported.[1] In both the models, the correlation is positive and significantly different from zero, i.e., 0.224 ($p < 0.001$) and 0.210 ($p < 0.05$). This tells that the hypothesis of mutually determined choices can be considered as meaningful and consistent. In other words, unobserved elements influencing the two choices are positively correlated, thus calling for a joint estimation rather than two distinct (and possibly biased) univariate models.

In both BP_1 and BP_2 models, socio-demographic variables (age, gender, residence in Italy) are not statistically significant with respect to the choice of visiting urban cities, while being more than 35 years old is negatively associated with using public transports with bikes. This result is in line with other studies reporting that older tourists prefer using private transports (Masiero and Zoltan, 2013; Hyde, 2008). Owning and usually using city bikes calls for urban destinations, but it is also coherent with a higher propensity to move within the city by using public transport. Notably, seasonality does not affect the two choices, whereas using bikes to run errands is the only out-of-tourism activity that shows, in both the models, significant and positive odds for visiting cities. A possible reason is that running errands by bike at least few times a week implies riding skills and acquaintance with road signs, thus this result is not-that-much surprising, as getting around cities for tourism purposes implies likewise actions. Bike tourism experiences outside Italy (typically, visited countries may include Austria, France, Germany, and Switzerland; Isnart-Legambiente, 2019) are likely to induce the choice of urban destinations. Indeed, foreign European cities are often considered as having a relatively higher tradition for cycling (among others, see Nilsson, 2019; Fishman, 2016; Cramer, 2014 for very similar findings). Also, daily trips by bike of more than 60 km during the cycling holidays are correlated with transit usage. In line with Le-Klähn et al. (2014), another positive link includes the length of stays, where spending 6 nights or more is associated with bike tourists visiting urban places and using public transport within the destinations. Interestingly, travelling in group is a factor giving a positive one with respect to preferring cities as tourism destination (also according to what reported in Koo et al., 2012), but a negative sign concerning the choice of using public transport together with bikes. The latter result is controversial and opposite to what found in Van Middlekoop et al. (2003). However, since those authors have considered tourists in general and they did not focus on bike tourists, from a transport policy view, our result suggests that public transport often may not be seen as fully able to meet the demand of bike tourism yet, especially for market segments including families and grouped bike lovers. Among different types of accommodation, lodging in B&Bs seems to be compatible with the choice of public transportation. Actually, tourists having those characteristics in common might entail a sort of social-based sustainability, as B&B usually offer personalized services, and provide tourists with the opportunity to recognize the local and cultural characteristics (Deng & Lee, 2019; Morrison et al., 1996). Lastly, in line with Hergesell & Dickinger (2013) and Kelly et al. (2007), we found a negative correlation between daily expenses on travel and the use of public transport, meaning that wealthier bike tourists may have a reduced demand elasticity to the price of private transport (e.g., fuel costs).

[1] The Wald statistic considers the ratio between the square of the correlation estimate and its own variance (Tauchen, 1985; Davidson and McKinnon, 1984; Kiefer, 1982).

What about the effects of destination and accommodation features included in the BP_2 model? Moving to those elements added to the baseline specification, we first notice that in the related model the goodness-of-fit has overall improved with respect to BP_1. The likelihood-ratio test builds on the χ^2 distribution with 32 degrees of freedom (46.19) and the related statistics, 58.58, is clearly above the 95% threshold. In the model BP_2 (assumed to be nested into BP_1), the error correlation is still significantly different from zero (see the Wald test outcome in Table 3). To evaluate the probability impact of changes in the explanatory variables (especially the added ones), conditional marginal effects are provided in Table 4.[2]

As for socio-demographic and travel-related characteristics, the changes in probability are clearly coherent with the estimated coefficients. More interestingly, most of cycling and destination factors (whose importance has been evaluated by the respondents on a 6-point Likert scale) displayed to be not particularly relevant. In general, this suggests that, even in case of cycling holidays spent in non-urban destinations (e.g., countryside, mountain, or seaside), several features related to bike lanes and available services have conceivable relevance. Therefore, there is no striking heterogeneity of bike tourists choosing between urban and non-urban sites. Yet, some statistically significant results deserve attention. First of all, a one-point increase in the importance of road traffic causes a 7% loss to the probability of visiting cities. This seems to support Han et al. (2017)'s claims for which bike tourists' needs in terms of safety and suitability for cycling are mostly fulfilled in rural places. By contrast, the odds of urban destinations are positively affected (+4.7%) if the availability of commercial services has a marginal raise in importance for cycling travellers. A probability gain of 4.3% in the choice of using public transport is, instead, displayed when bike-related services existing on the roads become more relevant for bikers. This is a result dealing with the ability by cycling tourists to choose multimodal travel solutions. As noted by Behrendt (2016), the connection between the Internet of Things and that of Bicycles asks for smart services to allow bike users to access either public transport systems or bike-related services. Regarding accommodation features, for both the choices, raising the importance of bike recovery by one point generates, respectively, a probability gain of 3.7% and 2.9%. This finding has a two-fold potential explanation. On the one hand, staying in facilities where bikes are safeguarded from theft is fairly a booster for the choice of urban cycling holidays. According to the 2019 Bicycle City Index, among the best performing cities in terms of theft score, some of them are typical bike tourism destinations, such as Barcelona, Strasbourg, Copenhagen, and Paris.[3] On the other hand, if bike tourists decide to take a day off from cycling and they do not use private cars (e.g., getting bikes on board), then their own bicycles should be properly looked after by B&Bs or hotels. Lastly, the relative importance of tourism support services by accommodation managers negatively correlates with the choice of public transport for intra-destination travels. The estimated probability loss is by 3.6%, and it might be explained by the extent of information gathered in advance by tourists. Following what found by Le-Klähn et al. (2014), besides collecting info, bike tourists tend to plan itineraries and buy public transport tickets before departure, thus being provided with such services by destination managers is rather irrelevant.

Table 3. Bivariate probit models. Estimation results.

Explanatory variables	**BP₁**		**BP₂**	
	City tourism	*Bikes and public transport*	*City tourism*	*Bikes and public transport*
	Coeff. (SE)	Coeff. (SE)	Coeff. (SE)	Coeff. (SE)
Age (0 = ≤35 years old; 1 = >35 years old)	-.012 (.078)	**-.269** (.080)**	.014 (.082)	**-.247** (.083)**
Gender (0 = Male; 1 = Female)	.058 (.109)	**.194* (.115)**	.013 (.113)	.155 (.118)
Residence in Italy (0 = Centre/South; 1 = North)	.023 (.115)	.063 (.107)	.056 (.118)	.012 (.122)
Type of bike owned (0 = other types; 1 = city bike)	**.189* (.102)**	**.341** (.109)**	**.253** (.103)**	**.385** (.112)**
Bike use: seasonality (0 = Warm months; 1 = All the year)	.068 (.103)	.105 (.106)	.053 (.105)	.099 (.108)
Commuting by bike (0 = Never/Seldom; 1 = At least few times a week)	-.004 (.106)	.144 (.109)	.011 (.108)	.129 (.111)

[2] Marginal effects are calculated by using conditional expected values, as follows: $E[y_m|y_n = 1; x_m, x_n] = P[y_m = 1|\, y_n = 1; x_m, x_n, \rho_{m;n}] \div P[y_n = 1; x_m]$, where $m, n = city, pub$.

[3] https://www.coya.com/bike/index-2019

Errands by bike (0 = Never/Seldom; 1 = At least few times a week)	**.314** (.103)**	.033 (.107)	**.330** (.106)**	.004 (.108)
Leisure by bike (0 = Never/Seldom; 1 = At least few times a week)	-.002 (.104)	-.116 (.111)	.001 (.104)	-.106 (.112)
Destination (0 = Italy; 1 = Abroad)	**.249** (.099)**	.066 (.107)	**.265** (.105)**	.074 (.110)
Travel group (0 = alone; 1 = one or more persons)	**.361** (.112)**	**-.388** (.124)**	**.408*** (.115)**	**-.392** (.124)**
Daily trips by bike (0 = <60 km; 1 = ≥60 km)	.015 (.052)	**.282*** (.055)**	.003 (.053)	**.262*** (.057)**
Type of accommodation (0 = other types; 1 = B&B)	.117 (.094)	**.300** (.102)**	.097 (.096)	**.273** (.105)**
Overnight stays (0 = <6 nights; 1 = ≥6 nights)	**.294*** (.063)**	**.191** (.067)**	**.269*** (.065)**	**.159** (.068)**
Av. daily per-capita expense (0 = <€50; 1 = ≥€50)	.035 (.067)	**-.145** (.071)**	.027 (.069)	**-.175** (.072)**
Constant	**-1.004*** (.212)**	.300 (.213)	**-.925** (.298)**	.422 (.316)
Cycling features at destination				
Intensity of urban road traffic	--	--	**-.188** (.058)**	-.010 (.060)
Available itineraries and tours	--	--	-.055 (.058)	.011 (.058)
Bike lanes: dedicated traffic signs	--	--	-.021 (.056)	-.046 (.059)
Bike lanes: safety	--	--	.054 (.053)	.013 (.057)
Available accommodations	--	--	-.026 (.057)	-.064 (.061)
Bike lanes: presence of bike stalls	--	--	.053 (.050)	-.073 (.053)
Bike lanes: maintenance	--	--	.078 (.051)	.012 (.054)
Bike lanes: availability	--	--	-.046 (.047)	-.042 (.046)
Available bike-related services	--	--	.064 (.061)	**.155** (.065)**
Available tourism offices	--	--	.048 (.044)	.054 (.047)
Available commercial services	--	--	**.123** (.046)**	.014 (.049)
Accommodation features at destination				
Available bikes recovery	--	--	**.109* (.055)**	**.119** (.057)**
Proximity to bike lanes	--	--	-.042 (.049)	-.036 (.051)
Available breakfast service	--	--	-.045 (.042)	.006 (.043)
Available tourism support	--	--	-.067 (.043)	**-.128** (.044)**
Available half-board service	--	--	-.034 (.035)	-.001 (.037)
Goodness-of-fit				
Observations	858		858	
Parameters	28		60	
Error correlation term ($\rho_{city;pub}$)	**.224*** (.059)**		**.210** (.061)**	
Wald test (H_0: $\rho_{city;pub} = 0$)	χ^2 (1;858) = 13.46, p-value < 0.001		χ^2 (1;858) = 11.32, p-value < 0.001	
Log-likelihood	-1010.93		-981.64	
Likelihood-ratio test	(BP_0, BP_1) 176.73, p-value < 0.001		(BP_1, BP_2) 58.58, p-value < 0.05	

Notes: *** p-value ≤ .001, ** p-value ≤ .01, * p-value ≤ .05. Robust SE are in parenthesis.

Table 4. Conditional effects of covariates on the dependent variables.

	City tourism	*Bikes and public transport*
Age (0 = ≤35 years old; 1 = >35 years old)	--	-7.4%
Errands by bike (0 = Never/Seldom; 1 = At least few times a week)	+12.8%	--
Destination (0 = Italy; 1 = Abroad)	+10.7%	--
Type of bike owned (0 = other types; 1 = city bike)	+9.0%	+11.0%
Travel group (0 = alone; 1 = one or more persons)	+17.8%	-13.3%
Daily trips by bike (0 = <60 km; 1 = ≥60 km)	--	+7.7%
Type of accommodation (0 = other types; 1 = B&B)	--	+7.9%
Overnight stays (0 = <6 nights; 1 = ≥6 nights)	+9.9%	+4.3%
Av. daily per-capita expense (0 = <€50; 1 = ≥€50)	--	-4.7%
Cycling features at destination		
Intensity of urban road traffic	-7.0%	--
Available bike-related services	--	+4.3%
Available commercial services	+4.7%	--
Accommodation features at destination		
Available bikes recovery	+3.7%	+2.9%
Available tourism support	--	-3.6%

Notes: only significant effects for at least one choice are reported in the table. "--" stands for "not statistically significant at 5%".

5. Conclusions

In the last years, cycling tourism has displayed many advantages for urban planning, including accessibility, land use, and travel capability (Procopiuk et al., 2020; Pucher et al., 2010). By following the philosophy of 'slow tourism', its focus has been shifting from mere environmental sustainability to the practice of time and space in urban areas in ways conducive to higher utility and well-being (Fullagar et al., 2012; Dickinson & Lumsdon, 2010). Under this framework, transportation modes such as buses, metro, tram, and trains can promote sustainability, but the extent at what using those public transport means is compatible with bike tourism experiences in urban places has not been sufficiently explored yet. Aiming to contribute to fill in that gap, this paper considered tourism sustainability by jointly investigating the choice of visiting cities and using public transport in intra-destination travels. Besides socio-demographic and travel-related aspects, the correlation of the two choices has been studied by incorporating individual-specific factors (Wu et al., 2011) related to the importance of information acquired before travelling, i.e., about cycling conditions and accommodations at destination. In fact, adding up those aspects improve the ability of the estimated bivariate model to explain the studied choices, providing novel results in the field of sustainable tourism.

First of all, we found a positive and significant correlation between unobserved factors affecting the choices of visiting cities during cycling holidays and of using public transportation to connect intra-destination places. This overall finding confirms that tourism movement patterns and transportation mode choices are linked (Le-Klähn et al., 2015; Masiero & Zoltan, 2013), but it adds relevant insights on bike tourists' preferences and needs. As reported in earlier studies, the likelihood of visiting urban places rather than rural destinations is intrinsically influenced by bike-related daily habits, such as the ownership of city bikes, and the propensity to use bikes to run errands. Larger travel groups and longer stays are compatible with city tourism experiences. Since the sample contains Italian bike tourists, having detected a higher tendence to visit foreign cities (rather than urban places in Italy) strongly depends on country-specific and cultural aspects. However, this result is still coherent, as it is widely recognized that the most attracting cities for bike tourists are in Northern-Central EU countries (Isnart-Legambiente, 2019). In parallel, our results confirmed that using public transport for intra-destination travels is strongly related to travel-related elements during cycling holidays, such as longer daily trips by bike, the choice of B&Bs (highly correlated with the bike tourists' need of social connection and slow-tourism attitudes; Parkins & Craig, 2006), more overnight stays, and (notably) less expensive holidays. Apart from improving the goodness-of-fit of the model, adding up scores given by tourists to the importance of cycling and accommodation features revealed as a useful strategy to get more information on their choices. Conceivably, bike tourists who are more sensitive to road traffic would avoid visiting cities, but the ability by urban places to provide with massive tertiary-field activities, such as commercial services, is clearly a plus. Nonetheless, the importance of bike-related services and of having own bikes looked after by accommodation hosts seems to also boost the use of public transportation, suggesting that the fulfillment of basic cycling needs would strengthen the quality of time that tourists take on their travels. In a sense, the perception of safety and care felt by bike tourists might provide the opportunity for greater engagement with local people, culture, and places, as pointed out, among others, by Dickinson & Lumsdon (2011).

From a policy and managerial perspective, the results displayed in this paper provide several insights about the interplay between urban cycling tourism and transport mode choices for intra-destination movements. As for considerations at a country level, Italy must keep investing into bike-friendly and attractive environments, especially in city contexts. A number of efforts have been made, also by Italy, to promote cycling in the last twenty years (see, e.g., Heinen et al., 2010), but this paper supports the idea for which, in the tourism domain, the policymakers must focus on bike lanes, inter-modal solutions at traffic nodes, and Internet-based mobility to enhance the choice of urban destinations (Behrendt, 2016). As a matter of fact, promotional campaigns and marketing plans by city destination managers should concentrate on infrastructure aimed at separating bike tourists from road traffic and its harms, but also on the supply of bike-related services in different spots of urban areas. According to the well-known Miossec (1977)'s model of touristic space theory, if cities in a region are connected by public transport systems, it is more likely to see urban destinations developing in terms of both attractiveness and sustainability. What is more, finding evidence about the correlation between city bike tourism and intra-destination use of public transport implies a sort of joint nudging of sustainable tourism by

considering that, according to Kim et al. (2019), promotional messages and travel personality have been found to influence the intention to visit.

Clearly, this research has some limitations, and it could be improved in different directions. First, the collected data refer to bike tourists living in a single country, thus the comparison with other cultural and geographical contexts would support the current findings. Second, the analysis focused on two joint choices only, and other potential decision about cycling holidays could give further explanations regarding bike tourists' preferences. Third, the underlining survey does not cover additional questions about sustainable habits in general, such as daily behaviours related to food and nutrition, waste disposal, car ownership, and ethics issues. Those aspects might provide the research on sustainable cycling tourism with a wider perspective on bikers' personality.

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