Assessing the role of public transportation to foster city bike tourism? The case of Italy

Crotti Daniele* - *Department of Economics, University of Insubria, Italy* Maggi

Elena - *Department of Economics, University of Insubria, Italy* Pantelaki

Evangelia - *Department of Economics, University of Insubria, Italy*

Abstract

Sustainability issues promote the combination of greener transport means when visiting urban environments. This paper focuses on bike tourists by analysing their choice of cities as a destination and the decision to use public transportation to connect within-destination places during holidays. By using data from an Italian survey on bike tourism in 2020, a bivariate probit model is used to study the role of socio-demographics, bike- related factors, travel characteristics, and cycling and accommodation features. The odds of visiting cities are positively affected by the length of stays, available commercial and bike recovery services, while the negative effect of road traffic is confirmed. Instead, combining bikes with public transportation is more likely for low- cost tourists, mainly lodging in B&Bs, and for people with higher sensitivity to bike-related services. From a transport policy perspective, our results support claims for sustainability measures jointly affecting tourists' decisions on destinations and travel mode choices.

Keywords: Sustainable travels, Cycling holidays, Urban tourism, Public transport, Bivariate probit.*JEL codes*: C25, L92, O18, Q56, R41, Z32.

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Data availability statement

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

* Corresponding author: daniele.crotti@uninsubria.it; Address: via Monte Generoso, 71 – 21100 Varese, Ph. number: +39

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Sustainability encaouragesthe combination of greener transport means when visiting urban environments. This paper focuses on bike tourists by analysing their choice of cities as a destination and the decision to use public transport to connect within-destination places during holidays. By using data from an Italian survey on bike tourism in 2020, a bivariate probit model is used to study the role of socio-demographics, bike-related factors, travel characteristics, and cycling and accommodation features. The odds of visiting cities are positively affected by the length of stays, available commercial and bike recovery services, while the negative effect of road traffic is confirmed. Instead, combining bikes with public transport is more likely for low-cost tourists, mainly lodging in B&Bs, and for people with higher sensitivity to bike-related services. From a transport policy perspective, our results support claims for sustainability measures jointly affecting tourists' decisions on destinations and travel mode choices.

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1. Introduction

In the last years bicycles have gained popularity in tourism, as these provide eco-friendly, healthy and natural travel experiences (Pantelaki et al., 2022). Although the use of cars is still dominant over more sustainable modes in many EU countries (Gössling & Peeters, 2015), the number of tourists who decide to spend most of their holidays by using bikes as the main transport mode has increased (Han et al., 2017). In particular, *slow travelling* has emerged as a way to visit places by using less polluting means of transport (e.g., trains; ECF, 2021) and within destinations by walking or cycling. When talking about bike tourism, according to Lumsdon (1996, page 27), despite recreational cycling might range from a part-day casual outing to a long distance touring holiday, the most interesting tourism activity involving bikes is *cycling holidays*, which implies one night or more away from home and cycling is the principal purpose of the holiday (ECF, 2012; Ritchie, 1998). According to the literature on tourism, at least one overnight stay is required in order to qualify bikers as cycling tourists, who tend to book mainly a central accommodation to reside and explore the region from this place (Aschauer et al., 2021). Therefore, although bikes could be used at the destination (e.g., hired or shared bikes), the impact of tourism does inherently depend on the extent at which bicycles are more or less combined with other means during tourism experiences (Buongiorno & Intini, 2021; Hjalager, 2015; Gössling, 2002). This aspect is of utmost relevance in urban areas, where the majority of population lives and flows of tourists contribute to air hindrance, noise pollution, congestion and accidents affecting environment, individual and community wellbeing, increasing health costs, causing productivity losses (due to congestion) and decreasing the life quality (Nilsson, 2019). Since urban tourism 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 including public transport and active modes like bikes (Romão & Bi, 2021; Koens et al., 2018).

Among countries with a high potentiality to attract bike tourists in urban areas, in this paper it is considered the case of Italy as one of the most visited and suitable for cycling holidays thanks to the growing provision of

bike-related infrastructures, including the accessibility to public transport (Maltese et al., 2021; Bergantino et al., 2021; Sottile et al., 2019). In the last years, Italy has reported a relevant growth in terms of cycling tourism by native and foreign bike tourists (in 2019, 62% and 38% respectively) (Isnart-Legambiente, 2020). More, Isnart-Legambiente (2019) reported that the cycle tourism contribution to the overall economy in Italy was about 4.6 million euros, i.e., 5.6% of the total expenditure of tourists in Italy in 2019. More recently, 50% of native tourists and 63% of foreigners declared to visit Italy for its richness in terms of cultural heritage (Isnart- Legambiente, 2020), with a clear-cut preference for North-Eastern regions as destinations (Figure 1). Yet, even though Italy is attractive for cycling holidays and slow tourism in general (Oh et al., 2016), from a multimodality point of view, in 2018 bike tourists displayed a lower daily expenditure on public transport services in urban contexts with respect to other tourists in Italy (8.32 vs. 14.90 euros), suggesting that the combination of bikes and public transport for tourism purposes may not be preferrable when moving across Italian cities (Isnart-Legambiente, 2019).

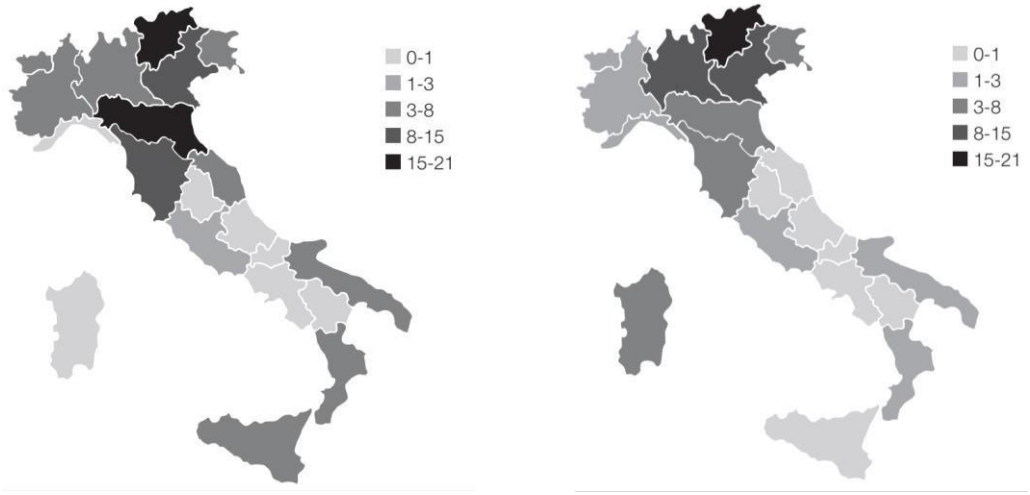

Figure 1. Native (left) and foreign (right) bike tourists per regional destinations in Italy (% of the total) – Source: Isnart-Legambiente (2020).

For these reasons and considering the importance of public transport within urban destinations to foster tourism sustainability, to the best of our knowledge, this is the first paper in Italy which contributes to the literature by focusing on the growing relevance of cycling holidays where tourists may decide to use private or public transport means with bikes for within-destination trips (Pantelaki et al., 2022; Magris & Ross, 2018). Specifically, by paying attention to the Italian case, the aim and novelty of this paper are to investigate bike tourists' preferences both on the choice of urban areas as destinations and of public transport together with bikes. Two binary dependent variables are considered, where the first distinguishes between urban (or city) and extra-urban destinations, while the second separates between private and public transport means used by tourists. Given that a linkage between the two decisions is assumed to explain better the bikers' behaviour in city tourism, in this study two bivariate probit models are contrasted. Both models include independent variables related to socio-demographics, bike-related habits, and trip features. One model also considers bike tourists' opinions about the importance of cycling conditions at destination (mostly related to bike lanes and the availability of services) and of key features making accommodations more bike-friendly. As expected, the bikers' utility in Italy increases where institutions and destination managers invest to increase the attractiveness of urban places. Analogously, if the relevance of those features for cycling tourists is significantly correlated to the choice of public transport during cycling holidays, then their inclusion in the model framework is expected to increase the understanding of the drivers of sustainable city tourism.

The remainder of the paper is organised as follows. Section 2 outlines the existing literature, while Section 3 presents the data and methodology used. Section 4 presents descriptive statistics of the variables used, while in Section 5 the results are presented and discussed. Finally, Section 6 provides brief policy considerations.

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 (among others, see Qiu et al., 2018; Leung & Law, 2010; Papatheodorou, 2001; Baloglu, 2000; Moscardo et al., 1996). For the purposes of this research, a notable reference is Wu et al. (2011) who identified factors influencing destination choices of tourists into three main groups: (1) alternative-specific factors, including the attributes of destinations, i.e., localization, attractiveness, tourism resources, accessibility, etc. (e.g., Awaritefe, 2004; Van Raaij & Francken, 1984); (2) situational factors, related to persistent and transient attributes of destinations, e.g., weather (Stemerding et al., 1999) and cultural/social situations (Kozak, 2002; Seddighi et al., 2001); and (3) decision maker-specific factors, linked to tourists' personal characteristics (Hsu et al., 2007; Ankomah et al., 1996). By investigating the factors which affect the choice of visiting cities during cycling holidays, and also influence the decision of using public transport (besides bikes) in intra-destination travels, this paper considers all the above factors and aspires to contribute to three related strands of literature.

The first strand relates to active modes (i.e., walking and/or cycling) in urban tourism, whereas the UNWTO defines it 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 highlights two main aspects. On the one hand, built environments, historical and cultural sites, metropolitan arts, and large-scale social interactions are key ingredients of city tourism, while natural landscapes and forms of extra-urban heritage are not central (Procopiuck et al., 2020). On the other hand, the sustainability of city tourism experiences crucially depends on the ability of local institutions, private operators, and destination managers to connect people and places by using attractive and low-impact transport networks (Gunter & Wöber, 2021). Regarding walking activities in urban contexts, recent studies showed how walkability is a key factor to attract tourists in the cities (Hall & Ram, 2018; Thompson & Schofield, 2007). Notably, in a survey of 466 domestic and international tourists in Munich (Germany), Le-Klähn & Hall (2015) reported that 60% of visitors preferred walking as a means of active transport either in conjunction with public transport or separately. More recently, Le Pira et al. (2021) developed a stated preference survey, where tourists' preferences are elicited with respect to alternative configurations of walking paths. By taking into consideration path accessibility and the interference with other modes of transport, the authors defined a "*tourist walking satisfaction indicator*". As for cycling, Ritchie et al. (2010, page 411) defined bike travels as a form of *"tourism that involves watching or participating in a cycling event or participating in independent or organised 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). Notably, Dickinson & Lumsdon (2010, page 138) clearly stated that *"Cycle tourism is not exclusively an extra-urban 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 that sense, many scholars have pointed out that the number of pro-environmentally minded tourists using bikes has steadily increased also in city tourism (among others Banet et al., 2022; Ho et al., 2015; Horton, 2006). As pointed out by Moscardo et al.

(1996), since permanent tourism attractions in an urban destination (e.g., historical sites) are key factors both influencing its choice and preserving its reputation), the accessibility to the cultural heritage in terms of transport systems was noted to influence the trips planning and the destination choice (Awaritefe, 2004; Siderelis & Moore, 1998). Finally, as noticed by Nilsson (2019), investments in infrastructure devoted to cycling tourists (i.e., bike lanes, cycle stands, bike boxes, etc.) have spread out in many urban environments, e.g., in Paris (Fishman, 2016; Fremiot, 2013) or in Berlin (Cramer, 2014). In this sense, a bike tourist is considered as a slow and active tourist visiting a variety of landscapes, interacting with local people and culture, enjoying local food, and stimulating the development of infrastructure, such as bicycle repair shops, and bike-friendly accommodation (Han et al., 2017; Dickinson & Lumsdon, 2010).

The second strand of literature refers to multimodal solutions combining bikes and local public transport (LPT) services for within-destination travels. Firstly, it is recognisable that the Netherlands, Denmark and Germany have a strong cycling culture (Groß & Grimm, 2019; Gronau & Kagermeier, 2007), while in the majority of other European countries, including Italy, the cycling mode share is low, between 2% and 5% (e.g., Sottile et al., 2021). In bike-oriented countries, thanks to well-established facilities and bike lanes, cycling tourism is therefore usually not limited to one location within a destination, but many micro-travels tend to occur inside cities (Schneider et al., 2022; Chen & Lee, 2017; Chen et al., 2014; Masiero & Zoltan, 2013; Dickinson & Lumsdon, 2010). Actually, the present paper focuses on the use of public transport together with bikes for intra-destination travels, substituting the use of private motorised vehicles to limit CO_2 emissions generated by tourism experiences (Hall et al., 2017). In fact, 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, including the choice of other transport means used by bike tourists. Similarly, Miravet et al. (2021) studied three demanding challenges that tourist destinations would need to face-up: to increase environmental sustainability, to enhance destination competitiveness, and finally to assure quality and comfort of public transport services for the local resident population. More, as argued by Masiero & Zoltan (2013), the choice of transport modes and of urban destinations are linked in a two-way direction, implying that tourism patterns and selected transport modes are related. Several considerations can be jointly involved in a single choice of tourism destinations and transport means (Rejon-Guardia et al., 2018). From a sustainability perspective, the choice of transport means to be paired with the use of bikes during cycling holidays (to reach the destination and/or to move within it often depends on the intensity of transport interconnection between or within different places. From a market perspective, the choice of cycle tourism destinations is generally affected by: (i) sociodemographic characteristics, (ii) the existence and quality of bike-friendly facilities and built environments, and (iii) the preferences of bike tourists in terms of accommodations and related features, including the proximity to bike lanes, dedicated guides, services to maintain and recover cycles, advice on special dietary requirements for cyclists, etc. (Weed et al., 2014; Lamont & Buultjens, 2011; Dolnicar, 2008). Yet, the reasons for not choosing public transport seem more straighforward, as argued by Le-Klähn et al. (2014): inconvenience and restrictions of the network, lack of information, disadvantages related to comfort or quality of service, and personal preferences. More, in Le- Klähn et al. (2015) it is observed that private modes seem preferable for visitors with more complex itineraries while having multiple purposes in a destination is suitable for public transport choices when the attractions and activities are relatively close and well connected. On the one hand, the use of bikes depends on the quality of cycling infrastructures, as they are often not compatible with cycling tourists' needs (Winters et al., 2016). On the other hand, the combination of bikes and other transport means plays a key role in intra-destination mobility. Several factors – such as the high flexibility in time and itineraries planning provided by private vehicles – explain the strong preference shown by tourists towards cars for intra-destination movements, (Taplin & Qiu, 1997; Tideswell & Faulkner, 1999). More, Hwang et al. (2003) noted that the availability of public transport might affect the choice of other means to be combined with transit (see also Thrasher et al.,

2000). From a planning perspective, Lau & McKercher (2006) identify factors influencing intra-destination patterns of tourists in relation to local transport and itineraries, such as human (related to the tourist), physical (characterising the destination such as transport networks, and attractions), and trip factors (e.g., type and duration). Regarding mode choices and engagement, Koo et al. (2012) found that more intense levels of social life and connections when travelling are correlated with the use of local transport, suggesting that the activity engagement is boosted by the city public transport. Le-Klähn et al. (2014) outlined that public transport users tend to have longer stays at destinations than non-users. 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, in general, Hergesell & Dickinger (2013) pointed out that the ticketing integration for transport services is a key factor affecting the use of public transport, followed by the time budget.

Finally, from a case-study point of view, the third strand of literature concerned by this study is related to the characteristics of cycling tourism in Italy and its growing importance for bike-related economy and touristic implications. With a focus on North-Western areas of Italy, Maggi et al. (2021) emphasised how extra-urban and emerging ones can be positively affected by the improvement of multimodal transport systems. More in general, Bergantino et al. (2021) recently provided a relevant overview of the Italian picture, underlining that Italy has made substantial steps towards the spread of a culture of cycling. Petino et al. (2021) showed the benefits of destination marketing organisations (DMOs)' strategies on the cycling tourism demand in Italy, especially when they entail the promotion of cultural sites and the protection of the surrounding environments by also supplying connected transport systems. In this line, Ruocco et al. (2020) presented strategies to enhance inner areas of the Cilento National Park in Italy, starting from the re-positioning of extra- urban areas and underlined the dynamics of cycle tourism as a way to recover from natural disasters (see also Di Giacobbe et al., 2021). With the aim of identifying the critical aspects of bike paths for sustainable tourism in Italy, Mazzulla et al. (2021) applied an importance-performance analysis (IPA) and confirmed that the issues of the bike paths mainly relate to safety (i.e., protection in relation to accidents) and to the degree of nuisance caused by pollution. Finally, in a companion paper sharing the dataset used in the present research, Pantelaki et al. (2022) applied a latent class approach to identify groups of bike tourists with segmented preferences. The authors found that the largest latent class in Italy is composed by bike tourists with the highest share of females, aged under 60 years old, and with a strong taste for collective transport, especially when visiting urban places.

3. Data and methodology

For the purposes of this research, data are 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). By using newsletters, open calls on web magazines and tourist-related websites to advertise the questionnaire and the purposes of the research, the survey was conducted among bike tourists living in different Italian regions but with similar familiarity with the concept and the practice of cycling tourism, e.g., members of cycling associations and/or people with knowledge of the use of bicycles in leisure times. The survey took about twenty days (with just one reminder after one week) and, after error- checking, 858 observations are used. As said, the two most relevant aspects studied in this paper referred to
(1) the choice of visiting cities in cycling holidays, and (2) using public vs. private transport means in combination with bikes for intra-destination trips. Concerning the first aspect, by using binary questions (0/1), the respondents were asked whether they prefer visiting urban or extra-urban destinations during bike tourism experiences. Regarding to the use 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 the above choices were created as follows: $y_{i,city}$ has value 1 if the bike tourist *i* visits cities, and 0 otherwise

(i.e., extra-urban places); $y_{i,pub}$ has value 1 if the bike tourist *i* use public transport during cycling holidays, and 0 otherwise (i.e., private motorised means). In order to investigate, on the one hand, the association between the choice of visiting urban cities and using public transports together with bikes, and, on the other hand, the associated role of destination and accommodation features for the above choices, in this paper two bivariate probit models were estimated and compared. As listed in Table 2, the first model (labelled with BP_1) considers socio-demographic variables, info about the general use of bikes, and trip-related aspects. In the survey, these aspects were studied by means of close multiple-choice questions. Instead, in the second model specification (BP_2), 5-point Likert-scales were added to the baseline specification and used to measure the bike tourists' evaluations of destination and accommodation items.

For this type of the analysis, in the literature the bivariate probit model is considered particularly appropriate, because it encompasses two equations with correlated disturbances (Train, 2003). A similar methodology was, for example, used by Eugenio-Martin and Campos-Soria (2010) to study the relation between regional climate in the home area and the choice of taking holidays in the origin region or abroad. Moreover, it was applied by Masiero and Zoltan (2013) to analyse the relationship between travel patterns (the number of visited regions) and travel mode choice in Switzerland, and by Le-Klähn et al. (2015), focusing on Munich (Germany) to link the choice of using public transport with the decision to visit an urban destination.
In this research the two following equations were estimated:

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

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 vectors of explanatory variables (with related coefficients Q'_{city} and Q'_{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 $y^*_{i,pub}$, implying that the choices are mutually determined.

Regarding the explanatory variables used to model tourists' choices, a set of covariates was selected according to the literature reviewed in Section 2. The first model considers socio-demographic aspects of cycling tourists, their use 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 the second model, 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.

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):

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

where, for the respondent i = 1,…, N, the probabilities $P(y_{city}, y_{pub} | x_{city}, x_{pub}) = \Phi_2(\mu_i; \Omega)$ depend on thebivariate standard normal distribution function, with arguments: $\mu_i = (k_{i,city}\beta'_{city}X_{i,city}, k_{i,pub}\beta'_{pub}X_{i,pub})$,

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 $\omega_{city;pub} \triangleq \omega_{pub;city} = k_{i,city}k_{i,pub}\rho_{city;pub}$.

4. Descriptive statistics of the variables

In Tables 1 and Table 2, summary statistics of dependent and explanatory variables are provided, respectively. As regard the binary dependent variables, 56% of bike tourists declared to visit urban places rather extra- urban destinations, while, during cycling holidays, 71% reported to use bikes combined with public transport.

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

Binary dependent variables	**N**	**Mean**	**SD**	**Min**	**Max**
City tourism = $y_{i,city}$	478	.5571	.4970	0	1
Public transport = $y_{i,pub}$	605	.7051	.4563	0	1

Concerning the explanatory variables, the first rows of Table 2 shows the statistics about socio-demographics factors. 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%). This geographical characteristic of our sample is in line with the findings of the available national statistics: the majority of the Italian bike tourists live in the Northern regions, such as Veneto, Lombardy, Emilia Romagna, Piedmont, Trentino Alto Adige (Isnart-Legambiente, 2020). Looking at 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).

Table 2. Summary statistics of explanatory variables.

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
	Touristic support by owners	2.76	1.45
	Available half-board service	2.61	1.59

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).

5. Econometric results and discussion

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 transport 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, two log-likelihood ratio tests are compared: 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. 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). In both models, the correlation is positive and significantly different from zero, i.e., 0.224 ($p < 0.001$) and 0.210 ($p < 0.05$). This means 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.

Table 3. Bivariate probit models. Estimation results.

Explanatory variables	**BP1**		**BP2**	
	City tourism	*Public transport*	*City tourism*	*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)
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 =	.035 (.067)	**-.145**	.027 (.069)	**-.175** (.072)**

€50)		**(.071)**		
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)
Touristic support by owners	--	--	-.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.

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, frequently 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 on cycling (among others, see Nilsson, 2019; Fishman, 2016; Cramer, 2014 for similar findings). Also, daily trips by bike of more than 60 km during the cycling holidays are correlated with public transport use. In line with Le-Klähn et al. (2014), another positive link includes the length of stays, where spending 6 overnight or more is associated with bike tourists visiting urban places and using public transport within the destinations. Interestingly, travelling in groups is positively correlated to the choice of city as tourism destination (also according to what reported in Koo et al., 2012), but negatively with the decision to use public transport together with bikes. The latter result is different from Van Middlekoop et al. (2003), who considered the whole tourism, without giving specific evidence on bike tourism. As a consequence, our result seems to suggest that public transport is often not seen as fully able to meet the demand of bike tourists, especially in case of families and group bike lovers. Among different types of accommodation, lodging in B&Bs seems to be compatible with the choice of public transport. Actually, tourists having those characteristics in common might entail a sort of social-based sustainability, as B&B usually offer personalised services, and provide tourists with the opportunity to recognise the local and cultural characteristics (Deng & Lee, 2019; Morrison et al., 1996). Lastly, in line with Hergesell & Dickinger (2013) and Kelly et al. (2007), a negative correlation is found 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).

What about the effects of destination/accommodation features included in the enriched *BP2* model? Moving to

these elements added to the baseline specification, 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 A1 in the Appendix. As for socio- demographic and travel-related characteristics, the changes in probability, considering destination and accommodation features, are clearly coherent with the estimated coefficients. Actually, most of cycling and destination factors (whose importance has been evaluated by the respondents on a 6-point Likert scale) didn't display particular relevance, suggesting that there is no striking heterogeneity of bike tourists choosing between urban and non-urban sites. In other terms, several features related to bike lanes and available services have conceivable relevance in cycling holidays both for urban and non-urban destinations (e.g., countryside, mountain, or seaside). As in Figure 2, some statistically significant results deserve attention.

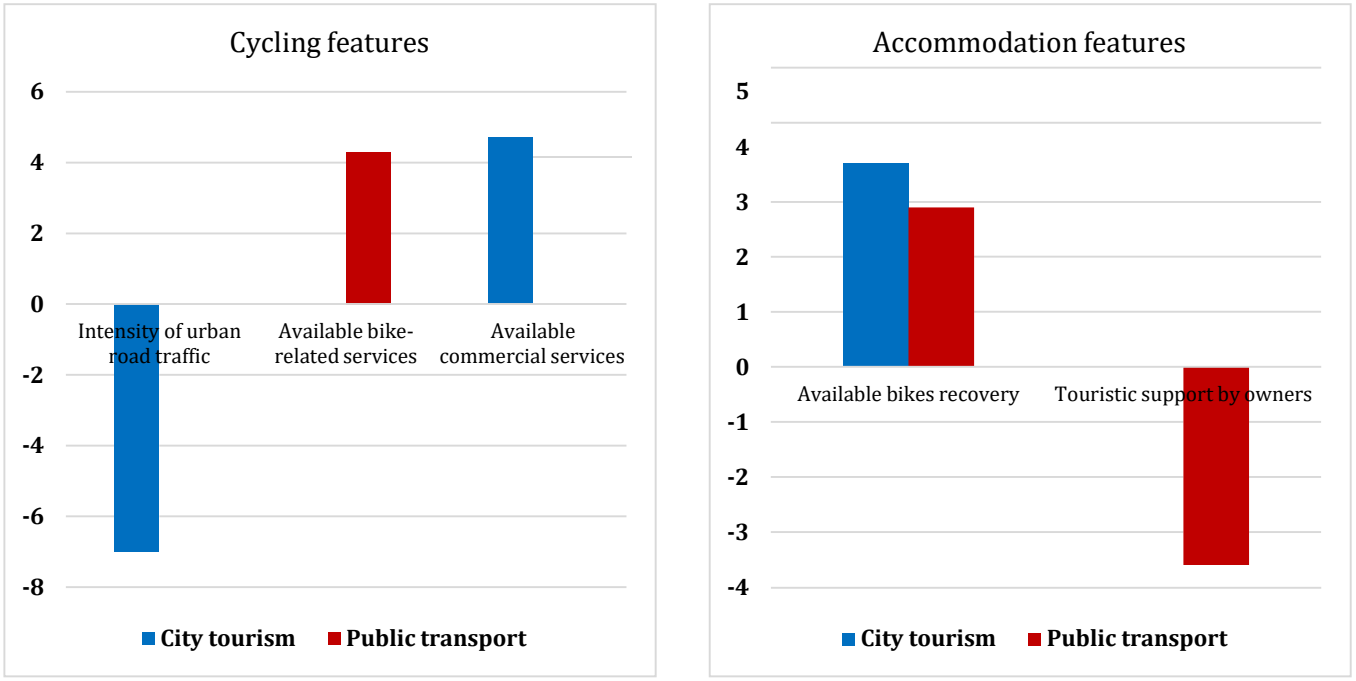

Figure 2. Conditional effects of (significant) covariates on the choice to visit urban destinations (blue) and to use public transport for within-destination travels (red) - % probability effects on choice odds.

First of all, a one-point increase in the importance of road traffic causes a 7% loss to the probability of visiting cities. This confirms the results found by Han et al. (2017) in extra-urban places, according which bike tourists' needs in terms of safety and suitability for cycling are most important. By contrast, the likelihood to use urban destinations increases (+4.7%), when the availability of commercial services has a marginal raise in the importance for cycling travellers. A probability gain of 4.3% in the choice of using public transport is, instead, displayed when the existence of bike-related services on the roads become more relevant for bikers. Thus, the choice of multimodal travel solutions is often related with the supply of other services; for example, Behrendt (2016) identified a connection between the availability of smart services and the use of public transport systems by bikers. Regarding accommodation features, for both the choices (destination and transport means), raising the importance of bike recovery by one point generates, respectively, a gain by 3.7% and 2.9% in terms of probability. 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 areas, where criminality is higher than in extra-urban places. According to the Bicycle City Index (2019), 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.[1] 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 in this Italian sample tend to plan itineraries and buy public transport tickets before departure, thus being provided with such services by destination managers is rather irrelevant.

5. Conclusions

According to the philosophy of slow travelling, city bike tourism experiences not only allow to achieve more environmental sustainability but also to achieve higher utility by enjoying urban landscapes and attractions (Procopiuk et al., 2020; Fullagar et al., 2012; Pucher et al., 2010; Dickinson & Lumsdon, 2010). Under this framework, the extent at what public transport is compatible with urban tourism experiences using bikes has not been sufficiently explored yet. To contribute to fill in that gap, the focus of this paper is Italy as being a country where the use of bikes for tourism purposes has strikingly grown in the last years. With the aim of envisaging policies to foster both the choice of urban destinations and the use of public transport by bike tourists, the linkage between those two choices was investigated. As a novelty of the current research with respect to scant previous studies about cycling tourism in Italy, besides socio-demographic and travel-related aspects, the correlation of the two choices has been studied by incorporating individual-specific factors related to the importance of cycling conditions and bike-friendly accommodations. Since the data were collected by a national survey conducted before the Covid-19 pandemic (early 2020), the results in the field of sustainable transport in tourism are of prospective relevance, as the sampled responses are not affected by risk-driven perceptions about travelling.

First of all, there is a positive and significant correlation between unobserved factors affecting the choices of visiting cities during cycling holidays and of using public transport to connect intra-destination places. This overall finding confirms that also in Italy tourism movement patterns and transport mode choices are linked (Le-Klähn et al., 2015; Masiero & Zoltan, 2013). As reported in earlier studies, visiting urban places rather than extra-urban destinations is a choice 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 as well. For the sampled Italian bike tourists, the eventual preference to visit foreign cities (rather than in Italy) depends on country-specific and cultural aspects and on the attention devoted to bike. In fact, it is widely recognised that the most attracting cities for bike tourists are in Northern-Central countries in the EU (Isnart-Legambiente, 2019). In parallel, our results confirmed that the use of public transport for intra-destination travels is related to some characteristics of the travel, such as longer daily trips by bike, the choice of B&Bs (correlated with the bike tourists' need of social connection and slow-tourism attitudes; Parkins & Craig, 2006), more overnight stays, and less expensive holidays.

1

As a further novelty, this study adds relevant insights on bike tourists' preferences and needs. The inclusion in the model of the scores given by tourists to the importance of cycling and accommodation features revealed to be a useful strategy to get more information on their choices, as well as to improve the goodness-of-fit of the model itself. Conceivably, bike tourists who are more sensitive to road traffic would avoid visiting cities, but the massive availability in urban places of tertiary-field activities, such as commercial services, is clearly an attractive factor. More, the importance of bike-related services and of having own bikes looked after by accommodation hosts seems to also boost the use of multimodal solutions. 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 present results provide 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. Even though several efforts have been made in the last twenty years, also by Italy, to promote cycling (e.g., Heinen et al., 2010), yet the findings highlight that more investments by policymakers and destination managers are needed, for example to increase the investments in safe bike lanes, inter-modal solutions at traffic nodes, Internet-based mobility and the supply of bike-related services in different spots of urban areas (Behrendt, 2016). According to the well-known Miossec (1977)'s model of touristic space theory, it is more likely to see urban destinations developing in terms of both attractiveness and sustainability if they are more connected by public transport systems, therefore sustainable urban mobility plans (SUMPs) should explicitly include aspects of tourism. More, promotional marketing campaigns – based on the evidence of a correlation between city bike tourism and intra-destination use of public transport – influence the intention to visit a city, e.g., by providing bike tourists with dedicated maps, integrated fares/bike card, and sharing services (Mundet et al., 2022; Kim et al., 2019).

Clearly, this research has some limitations, and it could be improved in different directions. Firstly, 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. Moreover, when it comes to urban tourism, in this paper there is not a distinction between large overcrowded art and historical cities (e.g., Rome) and medium- sized cities that might already have a more efficient infrastructure for cycling routes, therefore differentiated policies should be claimed for urban contexts with various cycling endowments and bike tourism attractiveness. Secondly, the analysis focused on two joint choices only, and other potential decisions about cycling holidays could give further explanations regarding bike tourists' preferences. Thirdly, 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. Further research efforts in this direction could provide a wider perspective on bikers' personality and on the way to attract them at the urban destination, combining the economic income coming from tourism with the environmental and social sustainability.

APPENDIX

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 $m, n = city, pub$.

Table A1. Conditional effects of covariates on the dependent variables.

Explanatory variables	*City tourism*	*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%
Touristic support by owners	--	-3.6%

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

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