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Multimodality at destination: A focus on domestic tourism

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ABSTRACT

Transport externalities can strongly affect the attractiveness of tourist destinations. Tourists' multimodality at destination, reducing private motorised mobility, improves sustainability and city appeal. The paper explores tourists' intention to utilise multiple modes of transport via a survey of more than 1900 potential tourists in Italy. It reports ordered probit model results, indicating that transport mode towards destination, information, and tourists' age are crucial. The beneficiaries of the results this paper produces are: 1) public decision-makers who can exploit this information when defining transport service characteristics (e.g., efficiency and comfort); 2) tour operators who can fruitfully use these results when including transport services in their products, along with accommodation and catering; 3) tourism managers who can stimulate multimodality by targeting specific initiatives to different population groups.

1. Introduction

Transport is responsible for a large part of tourism overall contribution to global warming (Gössling, 2002; Lenzen et al., 2018).

The ever-increasing tourists' flows - up to the sudden setback provoked by the Covid-19 pandemic-related restrictions in 2020 - and the consequent number of journeys towards and within destination, cause substantial external costs, such as pollution and congestion (Dubois et al., 2011; Gronau, 2017a). The consequent reduction of transport system efficiency negatively affects both the environment (Holden, 2016) and the attractiveness of tourism destinations (Boivin & Tanguay, 2019; Prideaux, 2000), especially for cities (Bellini & Pasquinelli, 2017; Larsen, 2019).

Transport generated by tourism depends on both supply (e.g., infrastructures and services, network and traffic management) and demand (e.g., tourists' mobility behaviour) factors (Wieckowski, 2021). This can impact sustainable mobility at destination (Scuttari et al., 2016) which, in turn, affects both the environment and landscape, thus influencing attractiveness (Gössling et al., 2010; Hopkins, 2020; Høyer, 2000).

Several authors identify multimodality - i.e., the use of different modes of transport on the same journey (European Commission, 2017) - as a solution for achieving sustainable mobility. It reduces private motorised ownership and mobility (Chlond, 2012; Nobis, 2007) and negative externalities (European Commission, 2020; Heinen & Mattioli, 2019; Oostendorp & Gebhardt, 2018). In fact, it increases synergic transport mode use, improves connectivity, fosters quality and safety, while minimizes transport-related impacts (Jarašūnienė et al., 2022; Myftiu, 2022). Groth and Kuhnimhof (2021) argue that multimodality depends on the quality of transport infrastructures, as well as transport policy and user behaviour.

Multimodality in tourism studies can refer to transport *towards* (i.e., from the place of residence to the destination), or *within* (i.e., from the accommodation place to various attractions) destination. The latter is much more relevant in fostering economic development and city/neighbourhood liveability compared to the former.

Supply has been explored more extensively than demand. Multimodality is linked to the availability of different modes of transport that can be used in a seamless combined trip-chain fashion (Müller et al., 2004). Research on passenger multimodality has, so far, focused almost exclusively on the journey to and from a destination and, typically, investigating transport infrastructural issues given the role policy and planning play within this realm. This stream of research has addressed physical accessibility and hubs/gateways service characteristics (Albalate & Bel, 2010; Jais & Marzuki, 2019; Ogryzek et al., 2020) rather than tourists' attitudes and behaviours (Verbeek & Mommaas,

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2008; Hall, 2013.

This paper aims to fill this gap by investigating tourists' intention of being multimodal at destination, thus providing public decision-makers, tour operators, and tourism managers with policy suggestions aimed at achieving sustainable mobility targets.

The research focuses on domestic tourism using Rome as a case study. This, not only because right after the pandemic (2021) 3 out of 4 tourists in Rome were Italians (Comune di Roma, 2023a), but also since they are closer, know both the language and geography better compared to international tourists, and thus are more likely to use a car when reaching the destination, which implies a higher propensity of using it when moving around the city. All of the above represents what multimodality tries to reduce. Moreover, Italy is characterised by one of the highest motorisation rates in Europe (Eurostat, 2024). No surprise that car constitutes the primary transport mode when travelling for leisure (Baumgartner et al., 2023). This is of specific concern given the lion's role domestic tourism has played in driving post-pandemic recovery (Rodrigues et al., 2021).

The paper rests upon a survey administered to more than 1900 Italians. Interviewees were asked to imagine a hypothetical trip to Rome. The questionnaire explores the potential tourists' propensity to be multimodal at destination through the investigation of their intention – i.e., the single best predictor of planned behaviour (Bagozzi et al., 1989; Kim & Hunter, 1993) and action (Ajzen, 1991) - to be multimodal.

Results allow to: (1) understand overall tourists' transport service needs; (2) shed light on their mobility pattern preferences; (3) characterise tourism package strategies to be adopted by operators; (4) provide policy makers with relevant information useful for tourists-related transport planning.

The paper includes 6 sections. After the Introduction, Section 2 reports a literature review. Section 3 describes the survey and the methodology, while Section 4 presents the case study. Section 5 reports the main findings deriving from the econometric model estimations. Section 6 concludes with a discussion on how to improve multimodality, sustainable tourism mobility, and the attractiveness of destinations, providing also specific policy suggestions arising from the results obtained.

2. Literature

This section includes three subsections. The first (2.1) focuses on a stricter multimodality definition, the second (2.2) concentrates on modal choices at destination, and the third (2.3) on reducing car use, with the overall objective of clarifying the specific research gaps this paper intends to address.

2.1. Tourists' multimodality

There are few papers investigating tourists' multimodality and they, apart from two exceptions, (i.e., Owen, 1991; Stubbs & Jegede, 1998), have been published in the last two decades.

One should distinguish between multimodal transport towards destination (MMT), and multimodal transport within destination (MMW). The latter represents the focus of this paper and can be captured by counting multiple modes used during the entire stay at destination.

Most literature on tourists' multimodal choice focuses on MMT, with an emphasis on accessibility as a key issue, broadly influenced by three different dimensions: *physical*, including infrastructures and service planning; *communication*, requiring both low cost and rich information; *economic*, foreseeing affordable transport tariffs (Van Wee et al., 2013). Kamb et al. (2021) suggest that tourists' choice of transport mode to their destination is primarily driven by economic considerations, namely price and travel time, rather than environmental concerns.

Notwithstanding MMW, closely associated with accessibility, is a crucial element in supporting local economies that rely on tourism and seasonal congestion (Jais & Marzuki, 2019), there are only few papers analysing tourists' MMW. Most of them address information availability. Bifulco and Leone (2014) suggest that estimating dynamic accessibility indexes allows operators to develop interactive maps tourists can utilise via a web-based platform, thus simplifying their multimodal journeys planning. Darmawan and Chen (2020), considering the low availability of integrated public transport information service in Taiwan, propose a "Connection Scan Algorithm" that provides relevant Local Public Transport (LPT) travel information, thus facilitating tourists' seamless journeys. At a city scale, Gavalas et al. (2015) develop the eCOMPASS app in Athens and Berlin, capable of providing tourists with personalised multimodal suggested tours, once they have defined the set of attractions they want to visit in a given time span.

More recent works investigate the cooperation intricacies multimodality at tourism destination poses for operators (Czernek-Marszałek, 2020). Mobility as a Service (MaaS) represents a tool to improve sustainable tourism since it provides integrated travel information on public and shared transport modes. Kim et al. (2021), via a tour-based stated choice experiment to people visiting Jeju Island in Korea, identify the possible synergy of using different modes through significant cross effects of sequence-specific travel modes, suggesting effective MaaS customisation for tourists. In the same vein, Meng et al. (2020) suggest promoting a close partnership between service providers and government to deploy effective policy initiatives supporting multimodal shared mobility for tourists and residents alike.

When examining the potential factors influencing MMW, it is crucial to consider that multimodality may negatively impact trip safety, comfort, speed, and convenience. This can be attributed to the inherent costs of locating and utilizing various transport modes at the holiday destination, as well as the unavoidable interchanges or transfers that accompany the availability of more travel options (Vuchic, 2006). This challenge becomes more pronounced when tourists are travelling independently, without the support of a tour operator, or lack familiarity with the destination, which is a common scenario for first-time visitors. Pricing emerges as one of the most significant determinants of multimodality. Gronau (2017b) advocates for a multi-level integration of ticketing systems along both vertical-geographical lines (local/international) and horizontal-stakeholder levels (residents/tourists). Lumsdon et al. (2006) exemplify this with the Wayfarer multimodal ticket, designed to promote more sustainable transport choices for countryside excursions. User profiling reveals that elderly people exhibit greater price sensitivity, highlighting the influence of cost, convenience, and flexibility on ticket selection. While time is paramount for commuters, transport within the destination requires more elements of spectacularity and scenic beauty over strict punctuality for tourists (Oostendorp & Gebhardt, 2018). This distinction is particularly relevant when the journey itself constitutes a central part of the travel experience (Larsen, 2001).

The limited literature on city multimodality propensity focuses on LPT users rather than specifically on tourists (e.g., Oostendorp et al., 2019; Zhou et al., 2022).

2.2. Tourists' modal choices at destination

Numerous studies explore the factors that shape tourists' modal choices at their destination. Building on the work of Lau and McKercher (2006), who collected GIS data from tourists in Hong Kong, it is possible to categorize the determinants of tourists' mobility choices in three main factor groups: (a) trip (e.g., type and duration); (b) human (e.g., demographics); and (c) physical (e.g., the transport network and the location of amenities within the destination).

Modal choice towards a destination can also have substantial implications for the modal choice within destination. Long-haul travellers, for example, tend to use more energy-efficient modes of transport once they arrive (Reilly et al., 2010). Hergesell and Dickinger (2013) find that when a train or bus is used instead of a car to reach a destination, the probability of using LPT during the stay increases. Similarly, Miravet et al. (2021) identify the mode of transport used to reach a destination as a key determinant of LPT usage at destination, alongside factors such as distance to the destination, length of stay, spending behaviour, and the intention to visit nearby neighbourhoods.

Furthermore, tourists' knowledge of available mobility options significantly influences their modal choices at destination (Bursa, Lamondia, & Mailer, 2022). Tourists with limited time and knowledge about the destination often rely more heavily on third-party recommendations (Garay Tamajón & Canoves Valiente, 2017).

Trip purpose can also play a pivotal role. Domènech et al. (2023), in their investigation of transport mode choices within Barcelona, reveal that tourists who opt for buses prioritize rapid access to attractions, while those who cycle prefer more flexible tourism experience. Conversely, tourists uninterested in visiting attractions display different modal preferences.

Many studies that delve deeply into tourists' modal choices focus predominantly on either active or collective modes of transport.

Active modes - whether driven by purpose, utility, or recreation (Karupiah & Bello Bada, 2018; Ram & Hall, 2018; Scheepers et al., 2014) - are widely acknowledged as the optimal means to fully experience a destination, particularly in urban settings, as they facilitate exploration, observation, discovery, and enjoyment (Kanellopoulou, 2018). Notably, Sustainable Urban Mobility Plan in art cities such as Florence, Bologna (Maltese, Gatta, & Marcucci, 2021) and Barcelona (Domènech et al., 2023) explicitly promote active modes to enhance the enjoyment of local attractions. The willingness to walk is influenced not only by demographic characteristics (Ujang & Muslim, 2014) but also by site features, such as cleanliness, green spaces, and the availability of restrooms along pathways connecting tourist attractions (Le Pira, Gemma, et al., 2021,Le Pira, Marcucci, & Gatta, 2021). Similarly, Gorrini and Bertini (2018) highlight the negative effects of inadequate basic services, overcrowding, and insufficient road signage on the tourist walking experience at destinations. Fewer studies address cycling specifically. Larsen (2016, 2017) investigates tourist cycling and bike sharing initiatives in Copenhagen, while Maltese and Zamparini (2021) examine how new cycling infrastructure within Milan could influence the time spent exploring the city. Crotti, Maggi, and Pantelaki (2023) focus on bike tourists' destination choices in Italy assessing the role LPT plays in fostering city bike tourism (Crotti et al., 2023).

When walking is not feasible due to distance or time constraints, tourists often turn to LPT, which is commonly available in cities due to high user density (Dickinson & Dickinson, 2006; Gronau & Kagermeier, 2007) and extensive transport infrastructure (Gronau, 2017b). LPT serves both as a feeder for long-haul transport and as a mean to reach tourist amenities and services. Its effectiveness depends on the level of accessibility it offers, its affordability (e.g., special promotions and tariff integration), and the availability of user-friendly information (e.g., language, signage, and technology) (Zamparini & Maltese, 2021). Studies examining tourists' willingness to use LPT indicate key factors, including younger age, higher education levels, environmental concerns (Le-Klähn & Hall, 2015), lack of access to private vehicles, and accessible information (Le-Klähn et al., 2015; Le-Klähn et al., 2014; Bieger & Laesser, 2004; Fodness & Murray, 1999; Kagermeier & Gronau, 2016). Familiarity with the destination remains crucial, as tourists often exhibit reluctance to use unknown bus networks, fearing delays, long waiting times, and the time required to gather necessary information (Gavalas et al., 2015).

2.3. Reducing car use

Tourists' preference for cars (OECD, 2016; White et al., 2019) is largely driven by both demand- and supply-side factors. Travellers carrying heavy luggage require comfort and flexibility, a need also shared by families travelling with children, elderly, or individuals with reduced mobility. Even for tourists without these specific peculiarities, inconveniences such as additional travel legs, waiting times, and transfer charges – particularly when fare systems are not integrated (Zhang et al., 2020) – pose significant barriers. Moreover, an insufficiently integrated and connected public transport network, combined with fragmented mobility platforms, poor information, and lack of integrated ticketing systems, exacerbates these issues (Briesner, 2022; Kamargianni et al., 2016).

Multiple studies have highlighted the strong and negative influence of car availability on multimodality (Groth & Kuhnimhof, 2021). Reducing car use often leads to a shift towards alternative transport modes (Tsirimpa et al., 2019). The impact of reward- and penalty-based measures on tourists' willingness to use LPT and cars is examined, respectively, by Dickinson et al. (2004) and Gronau (2017b). Azari et al. (2012) find that congestion pricing is more effective than park charges in encouraging modal shifts among tourists. More recently, Maltese and Zamparini (2022) identify several factors impacting tourists' adoption of green mobility alternatives instead of cars, such as destination distance and type (i.e., urban or rural), public transport access (plane, train, or coach), and accommodation arrangements. Maltese, Zamparini, and Amico (2021) compare residents and tourists' mobility patterns in Ischia, a small, densely populated Italian island where tourists can easily bring their cars. Their findings emphasize the need for improved LPT services and infrastructure for active modes to promote a modal shift away from car use towards sustainable transport at destinations. Additionally, it is important to note that in cities with regulated parking – where spaces are scarce and metered – car use becomes less economical, thereby nudging tourists towards more sustainable mobility choices (Dickinson et al., 2010; Dickinson & Dickinson, 2006; Woods & Masthoff, 2017).

In summary, a key issue emerging from the literature is the lack of detailed analyses of the multimodality concept within tourist destinations. In this context, in fact, studies focus on modal choice rather than on the combination of multiple transport modes within a single trip. This challenge is compounded by the diverse range of individual and collective transport options available in cities, including LPT, taxi services, car rentals, and car/bike/micro-mobility sharing services. In large cities, additional complexities arise. First, tourist traffic flows are complicated by city's multiple roles (e.g., entry point, exit point, travel hub for neighbouring areas). Second, distinguishing between tourist- and resident-generated transport issues is challenging. Furthermore, it is important to note that, on one side, tourists who do not use cars to reach their destinations are often compelled to adopt multimodality within the destination and, on the other, domestic tourists are more likely to travel by car compared to international tourists.

Based on these considerations, the paper addresses the identified research gaps by investigating Italian tourists' propensity for multimodal transport in the context of a hypothetical visit to Rome, focusing on domestic tourism while giving particular attention to how MMT might affect MMW.

3. Methodology

This section delves on data collection (3.1) and model estimation (3.2).

3.1. Questionnaire: Design and administration

The survey was designed and carried out with the intent to explore respondents' intention to be multimodal at destination considering a hypothetical trip to Rome. The decision to ask respondents to imagine their entire trip, with all its features, depended on the fact that, even if COVID-related restrictions were relaxed when the survey was administered (Spring, 2021), the most recent trip could probably have taken place a long time before, thus being difficult to recall in all its details.[1]

The questionnaire was administered via Google Form between 27 May and 27 June 2021. Specifically, during a face-to-face interaction, respondents provided answers the interviewers entered into the form. Both respondents and interviewers participated in the survey on a purely voluntary basis.

In order to ensure age group heterogeneity, the majority of interviews involved two members of the same household, one belonging to a younger generation and the other to an older one. Additionally, efforts were made to ensure that participants were from diverse geographical locations across Italy.

Following a preliminary trial conducted in May with a limited number of participants, some questions were revised and augmented, particularly with respect to the options for closed responses.

It should be noted that the technique used to identify respondents is based on an "adjusted snowball sampling" procedure. Given that the reference population is not known, it was decided to proceed using the dual scheme which, by requiring the answers from a subject and a member of his/her family of a different generation, made it possible to have a uniform distribution in terms of age.

Firstly, in terms of the individual interviewer's circle, only one level of respondents was considered, resulting in no degree of separation between the interviewer and the respondent. Secondly, the degree of separation between the respondent's relative, who was also a respondent, and the interviewer was limited to one level. This approach facilitated the expansion of the sample horizontally, enhancing the survey's effectiveness (Geddes et al., 2018). The use of the face-to-face mode also contributed to greater precision in data entry; moreover, these interviews facilitated the acquisition of more diverse referrals, thereby enhancing the diversity of the sample (Kirchherr & Charles, 2018).

The questionnaire includes three sections.

The first, in line with the literature (e.g., Lau & McKercher, 2006; Masiero & Zoltan, 2013), aims at gathering information on family size, composition, and mobility features such as: private car ownership (by fuel type), bike ownership, driving license, LPT and car/bike sharing subscription.

In the second section, respondents are asked to imagine visiting Rome and reply to questions concerning: season (OECD, 2016), length of stay (3 or 7 days), travel party size, main reasons for travelling (Domènech et al., 2023; Le-Klähn et al., 2015, 2014), accommodation type, and transport mode choice when travelling towards Rome, as well as the perceived feasibility of using a given number/type of transport modes (with LPT including metro, tram and bus with no further distinction) when travelling within the city (Hergesell & Dickinger, 2013). Interviewees are also asked to state their intention to be multimodal at destination, this representing the main focus of the paper.

In line with both the Theory of Planned Behaviour (TPB) by Ajzen (1991), on the left part of Fig. 1, and its adaptation in Shapero (1982) and Krueger (1993), on the right part of the same figure, intention and perceived feasibility are closely linked. The latter is affecting the former, thus reinforcing the predictive validity of intention alone over the actual behaviour adopted by the respondent (Krueger Jr et al., 2000).

One must acknowledge that stated preferences could have been used instead due to their potential advantages such as calculating the role certain attributes (e.g., distance, price, time, comfort) might play in explaining respondents' decisions. Given that no methodological silver bullet exists, it is important to underline that the paper is not so much interested in elucidating respondents' choices but rather exploring their intentions.

One can argue that the planning of a trip presupposes the acquisition of much information. This process can be assimilated to that of a business decision, the field in which Krueger has experimented and compared the two models.

On the one hand, there is a need for information to ascertain the feasibility, if only perceived feasibility, of travelling within the city visited in a uni- or multi-modal manner. This perceived feasibility influences the level of intention to utilise one or more modes of transport, which can subsequently translate into actual behaviour.

Complementary questions aim at capturing potential influencing factors with respect to being multimodal. In fact, poor information (e.g., in Dacko & Spalteholz, 2014), long interchange times (e.g., in Gavalas et al., 2015), inadequate interchange conditions (e.g., in Wardman, 2014) might discourage tourists from being multimodal. An additional aim of complementary questions is to ascertain the perceived benefits multimodality can bring to society, namely: negative externalities reduction (e.g., in Heinen & Mattioli, 2019; Jarašūnienė et al., 2022) and increased site attractiveness for tourists (e.g., in Liu et al., 2013).

The last section collects socio-demographic data, including age, gender, residence, education, and employment, which, according to the literature, can help explain the tourists' choice to be multimodal (e.g., in Le-Klähn & Hall, 2015; Le-Klähn et al., 2015; Le-Klähn et al., 2014).

3.2. The model: Ordered probit structure

The paper adopts an ordered modelling structure (e.g., Aitchison & Silvey, 1957; Greene & Hensher, 2010a, 2010b), which represents an appropriate analytical framework whenever survey responses are ordinal (Chu, 2002; Daykin & Moffatt, 2002). The dependent variable is the self-reported intention to be multimodal when travelling within Rome. Specifically, it represents the intention to use more than one transport mode during the tourism stay in Rome and can take four ordered outcomes: Null/1, Low/2, Medium/3 and High/4.

Defining the dependent variable as y and setting $k_0 = -\infty$ and $k_4 = +\infty$, the values of the latent intention y^* might fall in a region delimited by three cut points in sequence: k_1, k_2 and k_3, with the related ordered model reported below:

$$y_i = g(y_i^*) = \begin{cases} 1\ (Null)\ if\ k_0 < y_i^* \leq k_1 \\ 2\ (Low)\ if\ k_1 < y_i^* \leq k_2 \\ 3\ (Medium)\ if\ k_2 < y_i^* \leq k_3 \\ 4\ (High)\ if\ k_3 < y_i^* \leq k_4 \end{cases}$$

for each respondent $i = 1, 2, \ldots., 1906$, where $g(\bullet)$ is the link function connecting the latent variables y_i^* to y_i. As the ordered probit model assumes that y_i^* depends linearly on $\boldsymbol{X}_i$, according to $y_i^* = \boldsymbol{\beta}\boldsymbol{X}_i + \varepsilon_i$, (where ε_i are random errors with zero mean and unit variance), for any $y_i = j$, with $j = 1, 2, 3, 4$, let $P_i(y_i) = P(k_{j-1} < y_i^* \leq k_j) = \varphi(k_j - \boldsymbol{\beta}\boldsymbol{X}_i) - \varphi(k_{j-1} - \boldsymbol{\beta}\boldsymbol{X}_i)$ be the probability that the $i-$ th respondent's outcome is j, where $\boldsymbol{X}_i$ is the vector of individual characteristics considered relevant in explaining the sampled tourists' intention to be multimodal within Rome. Those variables are described in the Appendix (Tables A1 and A2).

The vector $\boldsymbol{\beta}$ collects all coefficient estimates, without intercept to obtain an identifiable model (as Greene and Hensher (2010a, 2010b) note, if a cut-point is constrained to zero, then one can identify the intercept, while allowing cut-points to be flexible implies removing it), and $\varphi(\bullet)$ represents the standard normal cumulative distribution function. The corresponding log-likelihood function is:

[1] While there is inevitably an impact that a pandemic situation has on the hypothetical choices a given interviewee might take, it has been considered as negligible since when administering the questionnaire, interviewees were explicitly asked to respond assuming to make a decision based on their potential "previous experience" thus inducing them to think in a non-pandemic context.

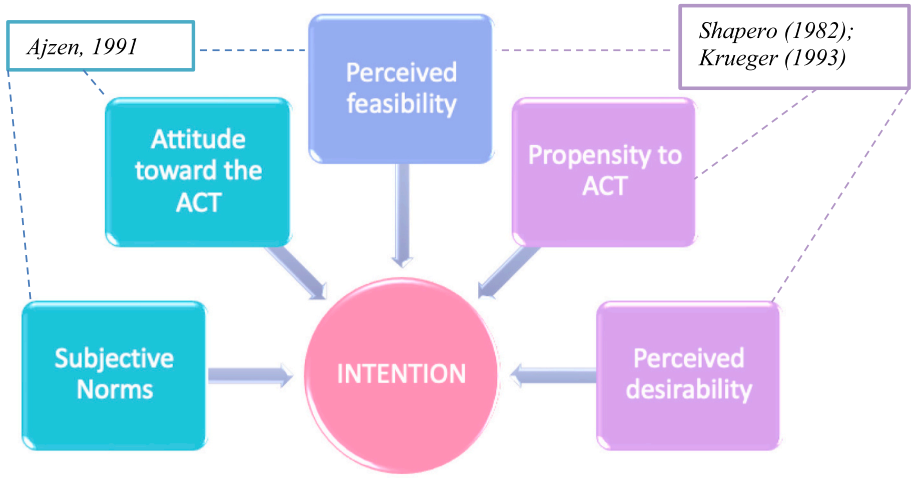

Fig. 1. - The link between Intention and Perceived Feasibility in Ajzen's and Shapero-Krueger's models.
Source: Authors' elaboration on Krueger Jr et al. *(2000)*.

$$L = \sum_{i=1}^{1906} ln[P_i(y_i)] = \sum_{i=1}^{1906} ln[\varphi(k_j - \boldsymbol{\beta X}_i) - \varphi(k_{j-1} - \boldsymbol{\beta X}_i)]\ L$$

$$= \sum_{i=1}^{1906} \sum_{j=1}^{4} z_{ij} lnP(y_i = j) = \sum_{i=1}^{1906} \sum_{j=1}^{4} z_{ij} ln(\Phi(k_j - \boldsymbol{\beta X}_i) - \Phi(k_{j-1} - \boldsymbol{\beta X}_i))$$

, where z_{ij} is an indicator variable, assumes the value of 1 if $y_i = j$ and 0 otherwise. The paper uses Stata (release 17), to maximise this function with respect to $\boldsymbol{\beta}$, and the cut points k_1, k_2 and k_3 (see, e.g., Long & Freese, 2003).

Tables A1 and A2 in the Appendix list dummy covariates, baseline

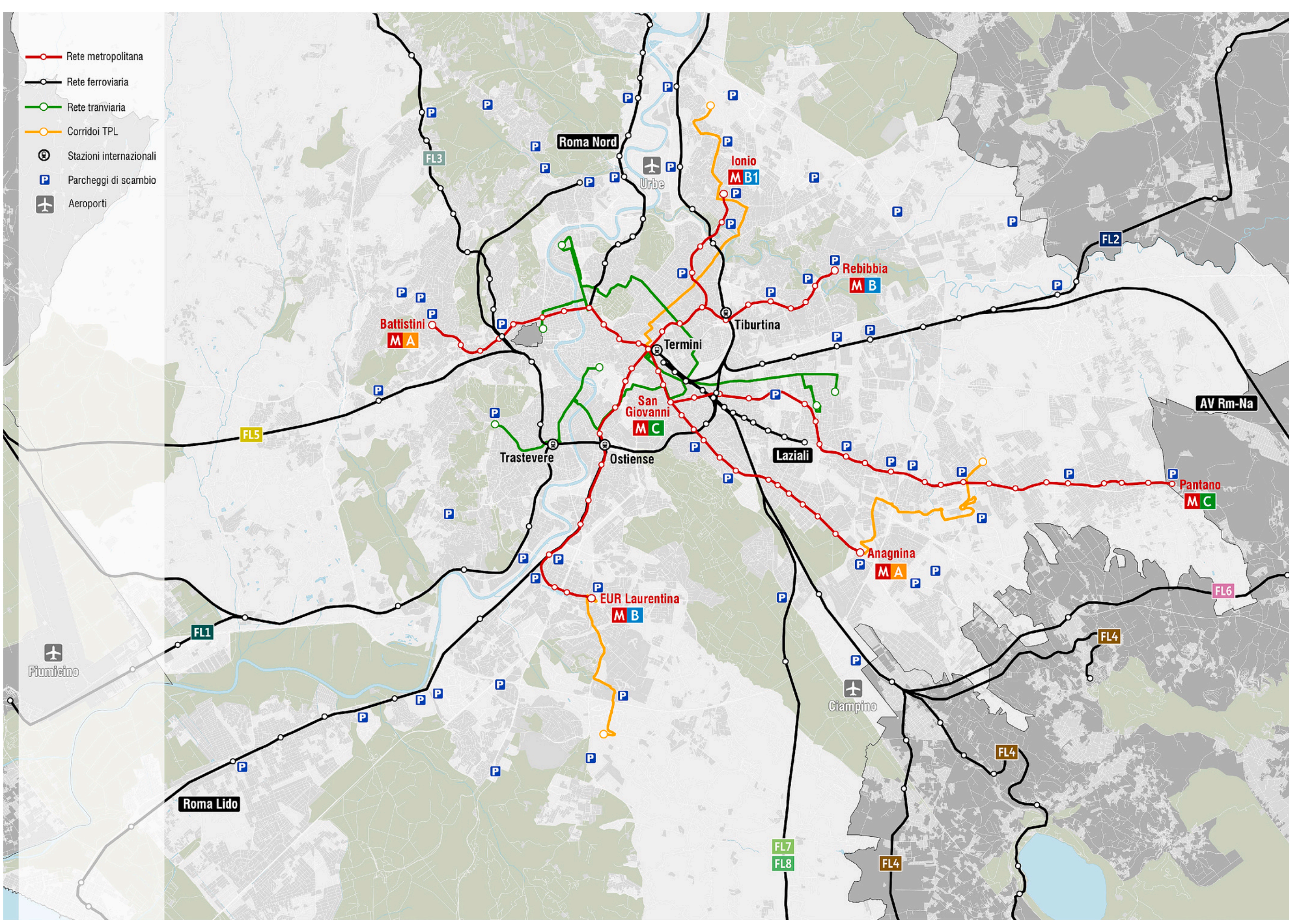

Fig. 2. - LPT (Railway) map in Rome, 2024.
Source: Courtesy of RSM- Roma Servizi per la Mobilità.

ones, and additional qualitative covariates referring to perceived/subjective drawbacks and benefits with respect to MMT and MMW. It is important to note that the questionnaire was developed so to induce interviewees adopting an individual perspective when considering *drawbacks*, and a social one for *benefits*.

4. Case study description

This section illustrates transport and tourism in Rome (4.1) and describes the main characteristics of the sample (4.2).

4.1. Transport and tourism in Rome

Transport in Rome is characterised by several shortcomings such as low public station density, inadequate pedestrian infrastructures, poor paths conditions, and limited cycling network. Rome is one of the most congested cities in the world, with 134,14 million hours lost in traffic every year (Comune di Roma, 2020). The total number of vehicles (private and public: 2,326,147) is close to the potential driver population (2,337,226). Motorisation rates are among the highest in Europe: 621 cars and 138 motorbikes each 1000 inhabitants, with more than 4500 vehicles circulating per urbanized square kilometre (ISTAT, 2022). Romans are concerned about air (68.7 %) and noise pollution (56.9 %) and upset (80 %) for poor road surface conditions (Eurostat, 2024).

Overall, Rome is very large and populated (ISTAT, 2022). The rail-based public transport system includes three metro-lines (the fourth is currently being planned), seven tram-lines (other 4 will be constructed by 2030), and three urban railway-lines (red, green, and blue lines in Fig. 2, respectively). The urban bus transport network relies on around 350 lines, spanning a 2,200 Km network, with a fleet of around 2,500 vehicles (Comune di Roma, 2023b, 2024). Despite its extensive and widespread coverage, the service is characterised by low-medium frequency lines (Gemma et al., 2022); in fact, a recent survey by Eurostat (2024) reports that in 2023 residents were dissatisfied with LPT service quality (70.2 %), which is perceived affordable (66.6 %), but unsafe (53.4 %), not so easy-to-get (50.6 %), infrequent (70 %), and unreliable (78.1 %). Additionally, the official not-so-friendly urban "mobility" website does not contain bike sharing information, even if the service is available.

Rome belongs to the "big cities" category, according to a recent tourism classification provided by the Italian National Institute of Statistics (ISTAT). This category includes 12 major cities with the highest tourist density. Rome presents specific cultural, history, lake, and maritime tourism features (ISTAT, 2022). Data on global tourist flows indicate that Rome is one of the most appealing cities to visit worldwide. In fact, in 2018, tourists spent in Rome 35 million nights (Comune di Roma, 2020).

In 2019 foreign tourists accounted for 53 % of the total, while domestic flows grew by 61.4 % in the five-year period 2015–2019. Foreign tourists spent on average more time in the city compared to Italian ones (i.e., 2.5 vs. 2.2 nights, respectively). Foreigners prefer hotels to complementary establishments, while the opposite is true for Italians.

It can be confirmed that Rome is the leading destination in Italy, accounting for 7.1 % of national total visits (4.9 % of domestic tourism). In 2022 there has been a notable recovery in visitor numbers compared to pre-pandemic levels, with a 226.5 % increase in visits to this municipality compared to 2021 (ISTAT, 2023).

In 2021, Italian tourists account for two thirds of the capital's tourist demand. Their average stay is 2.2 nights, with 44.4 % using hotels and 55.6 % non-hotel establishments (Comune di Roma, 2023a).

Italian tourists visiting Rome can fly, take a high-speed rail, or use one of the 8 regional railway lines connecting the city with its surroundings. Accessibility to Rome is linked to its central location with respect to the Country (Fig. 3) be it measured by travel time/distance (Bucci et al., 2021) or by generalized costs (Beria et al., 2017).

Tourists can purchase "Roma Pass", a card allowing them to combine

Fig. 3. - Map of Italy and its Capital City Rome.
Source: Authors' elaboration on D-Maps (https://d-maps.com/carte.php?num_car=2322&lang=it).

museum/archaeological site entrance with free (48 or 72 h) public transport. Alternatively, they can purchase integrated 1-, 2-, 3- or 7-days tickets for unlimited LPT use.

There are different motivations for choosing Rome as the focus of this paper.

Rome suffers from over-tourism, which is linked to the excessive pressure visitors pose on urban environment and local population (Koens & Postma, 2017; Maitland & Ritchie, 2009; Postma et al., 2017; Selby, 2004; Stock, 2007). The impact COVID-19 has had on tourism proved to be temporary. This is especially true for art-cities that still suffer from overcrowding that engender spatial and temporal imbalances (Yang et al., 2022; Coconi et al., 2024; Liberatore, Biagioni, Ciappei, & Francini, 2023).

The sustainability challenges tourism poses to a tourist-historic city, taking advantage of its unique past (Spirou, 2011) and atmosphere, are particularly relevant (Bertocchi & Visentin, 2019; Caserta & Russo, 2002; Dodds & Butler, 2019; García-Hernández et al., 2017; Maitland, 2006; Russo, 2002; Seraphin et al., 2018). Jurado-Rivas and Sánchez-Rivero (2019) suggest that tourists are more willing to pay for sustainable products and services when visiting world heritage cities.

Rome is a city with stable weather. This promotes active mobility and multimodality. The capital city of Italy is well known to all Italians and conveniently located in the centre of the Country. This also motivates the focus on domestic tourism alone thus avoiding potential confounding (e.g., language, currency exchange, etc.) and endogeneity (e.g., air transport) effects, relevant when investigating multimodality at destination.

4.2. The sample

The survey involves 1906 respondents.

Table 1 and Table 2 describe the main demographics and mobility characteristics of the sample. Table 3 focuses on travel-related features,

Table 1
- Demographics of the sample.

Variables		N	%
Age	Under 30	925	48.5
	30 and over	981	51.5
Gender	Male	848	44.5
	Female	1058	55.5
Education	Primary or middle school	293	15.4
	High school	1155	60.6
	Bachelor	398	20.9
	Master/PhD	60	3.2
Occupation	Unemployed/Student/Retired	946	49.6
	Employed	960	50.4
Urban residence	Not a Province (NUTS3) capital	1421	74.6
	Province (NUTS3) capital	485	25.4
Region location	South to Rome	280	14.7
	North to Rome	1626	85.3

Table 2
- Mobility aspects of the sample.

Variables		N	%
Cars	Not present	60	3.2
	One or more in the household	1846	96.8
Bicycles	Not present	303	15.9
	One or more in the household	1603	84.1
Driving license	Not present	53	2.8
	One or more in the household	1853	97.2
LPT subscription	Not present	1003	52.6
	One or more in the household	903	47.4
Sharing subscription	Not present	1760	92.3
	One or more in the household	146	7.7

Table 3
- Travel features of the sample.

Variables		N	%
Length of stay	Weekend or less	863	45.3
	More than a weekend	1043	54.7
Travel group	Alone	55	2.9
	In couple	612	32.1
	With friends/colleagues	573	30.1
	With family members	666	34.9
Accommodation	Friends or relatives' home, etc.	470	24.7
	Hotel or B&B	1436	75.3
Travel season	Winter	121	6.3
	Spring	955	50.1
	Summer	571	30.0
	Autumn	259	13.6
Travel motivation	Extra-urban tourism	726	38.1
	Urban tourism	1180	61.9

Table 4
- Main mode towards and multimodality within (MMW) Rome.

Variables		N	%
Travel type to Rome	Stop-overs	306	16.1
	Direct trip	1600	83.9
Main mode towards Rome	Train	975	51.2
	Airplane	612	32.0
	Long-haul coach	66	3.5
	Private car	253	13.3
MMW – number of modes perceived feasible	Two modes or less	1155	60.6
	More than two modes	751	39.4
MMW – type of modes perceived feasible	Active Modes (AM) + Public modes	1004	52.7
	AM (Only active modes)	219	11.5
	AM + Individual Motorised Modes	683	35.8

while Table 4 delves on multimodality.

Women are more than half of the sample (56 %). The average age is 37, with a minimum of 13 and a maximum of 87, and 14 % of respondents are more than 65, while about 40 % fall in the 18–25 range.

It is worth remembering that interviewers were students. They mostly administered the questionnaire to classmates, friends, and their family members. This explains the prevalence of respondents in the young people and adults' generational groups. Respondents are mostly from Northern and Central Italy (85 %).

Table 2 reports that 97 % of respondents have at least one car in the household, and 84 % have at least one bicycle. Just 47 % have a LPT season ticket. Car and/or bike sharing subscribers are few (7.7 %).

According to Table 3, 55 % of the sample would spend 2 nights when visiting Rome, which is in line with the average length of stay for Italian tourists in Rome (2.2) provided by official data (Comune di Roma, 2023a). They are mostly staying in hotels or B&Bs (75 %). More precisely, 42.3 % of the sample would prefer hotel establishments, and among these, 51 % would choose a 4- or 5-star one. This is also which in line with the official data provided by the Municipality of Rome (ibidem) about preference for hotels (44.4 %) and, among these, for the highest level of service (51.7 %).

Half of the respondents would prefer travelling in Spring (50 %) and, as supported by other data sources (e.g., EBLT, 2018; MiBACT, 2018; CMRC, 2022), with the main motivation of getting around the city to visit its cultural and historical attractions (62 %).

Table 4 shows that 84 % of the sample would travel to Rome without stop-overs, typically using train (51 %).

Respondents, in line with the TPB (Ajzen, 1991), were asked about their perceived feasibility with respect to different available transport modes that they could use to move around in Rome. The question asked reads as follows: *"Once at destination, which of the available modes listed below you consider feasible to use?"*. The possible modes are*: On Foot; Bicycle; Motorbike; Local Public Transport (Urban Train - Tram - Bus - Metro); Car; Boat; Camper; Bike sharing/renting; Car sharing/renting; Scooter; Taxi; Tour bus; Coach.*

Results indicate that 11.5 % considers only active modes feasible to get around Rome, while 52.7 % envisions feasible using active modes in combination with LPT; and the remaining 35.8 % in combination with individual motorised modes (e.g., owned/rent/shared cars, taxi, etc.).

Fig. 4 displays the possible connection between the main mode used to reach Rome and the MMW type of perceived feasible modes.

It is important to distinguish between road-related (i.e., private car and long-haul coach) and air/rail-related modes for travelling towards Rome. In fact, when tourists state they would use the former to reach Rome, then they mostly perceive feasible using active modes and individual motorised modes to travel within the city (private car 60.1 % and long-haul coach 42.4 %), whereas when they state they would use rail or air, their perceived feasibility of using the same modes to move around the city would respectively fall to 31.1 % and 32.4 %. Since the percentage of tourists perceiving feasible using active modes only is, *de facto*, independent of the mode used to reach the city, not surprisingly, the considerations with respect to "active modes + LPT" are specular with respect to those expressed for "active modes + individual motorised modes".

Table 5 illustrates the possible factors influencing both MMT and MMW. Respondents were asked to identify any inconveniences associated with multimodality from their point of view. They were prompted to consider both aspects related to the experience at the destination and certain activities prior to departure.

The comparison between MMT and MMW clarifies that the value of time and luggage-related driven issues play a greater role for the former, in line with Bursa, Mailer, and Axhausen (2022), while information and economic factors are more relevant for the latter.

Respondents were also asked to indicate the possible benefits of multimodality for the destination city as a whole. The response options included both reduction in transport negative externalities (air and noise

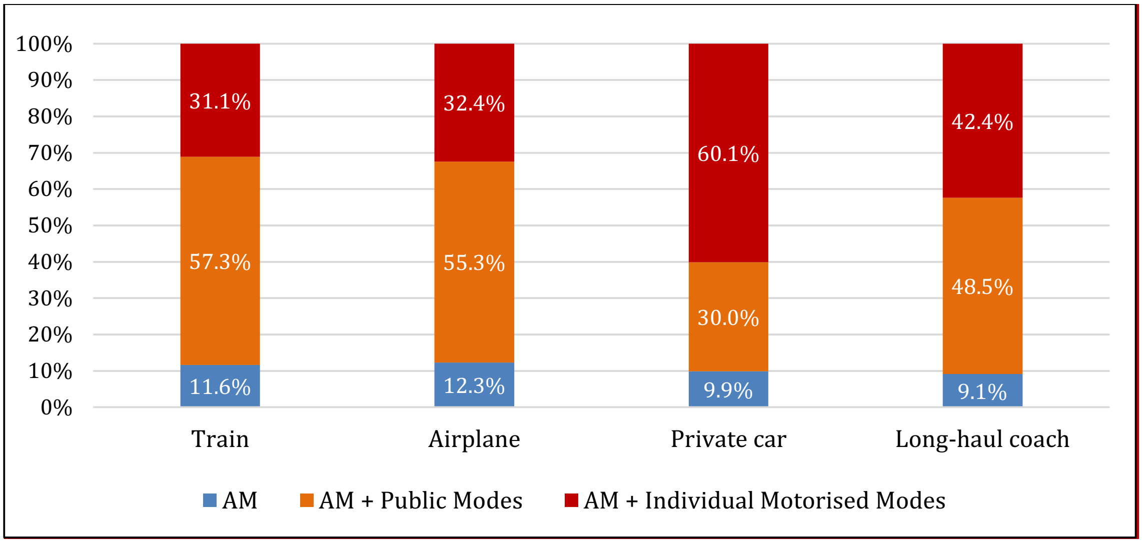

Fig. 4. - Cross-analysis of main mode towards Rome and MMW Rome mode choices.
Note: Independence scores (Pearson's chi-square tests, 2 df): Train, 20.8442, p = 0.0000; Airplane, 14.4830, p = 0.0016; Private car, 76.8873, p = 0.0000; Long-haul coach, 13.3990, p = 0.0049.

Table 5
Factors influencing MMT and MMW.

	MMT	MMW
	N (%)	N (%)
Luggage handling	1324 (69.5 %)	700 (36.7 %)
Dwell times	1251 (65.6 %)	724 (38.0 %)
Interchange operations	934 (49.0 %)	903 (47.4 %)
Ticket fares	918 (48.2 %)	961 (50.4 %)
Ticket management	714 (37.5 %)	784 (41.1 %)
Information management	637 (33.4 %)	905 (47.5 %)

pollution, visual intrusion) and improvement in urban aspects (beauty, liveability, tourism attractiveness, sustainable mobility). Table 6 summarizes MMW potential benefits.

Respondents mostly (i.e., over 70 %) consider multimodality beneficial to promote sustainable mobility (76.5 %), while also relevant to increase city liveability (74.7 %) and tourism attractiveness (72.1 %), as well as to reduce air pollution (70.7 %).

Interestingly, according to Fig. 5, tourists who are less interested in the aesthetic aspects such as beauty and unobstructed views are those who prefer public transport over exclusive active mobility or private individual transport.

Table 7 displays the stated intention of being multimodal within Rome. It is based on the question:

> "*How willing would you be to be multimodal, i.e., to use more than one means of transport during your stay in Rome?*". The possible options are: *Null/1, Low/2, Medium/3 and High/4.*

Approximately 57 % of the interviewees declare a medium/ high intention towards multimodality.

Table 6
- Potential MMW benefits.

	N (%)
Sustainable mobility	1458 (76.5 %)
City liveability	1424 (74.7 %)
City beauty	897 (47.1 %)
Less air pollution	1348 (70.7 %)
Less noise pollution	1175 (61.6 %)
Less visual intrusion	955 (50.1 %)
Tourism attractiveness	1374 (72.1 %)

Tourists perceiving feasible moving around Rome by active modes in combination with LPT show a higher intention of being multimodal (Fig. 6).

This represents the focus of the remaining part of the paper.

It is worth noting the presence of those tourists who consider it feasible to use active mobility together with collective or individual modes (red and green category, respectively), even in the first two columns, where the intention to be multimodal is nil or low.

This is in apparent contradiction with their attitude towards the number and type of means of transport, which can be explained by the fact that, once again, the lack of perception of active mobility as autonomous may weigh heavily, favouring the idea that it is only functional to reach the terminus and public transport stops, or the individual means of transport in a parking area or a rental shop, which makes them perceive their choices as unimodal.

5. Results

This section illustrates the results of two alternative specifications of an ordered probit model. The first (OP_0) specifies the ordered outcome (Null/1 ÷ High/4) using socio-demographic, tourism-related and MMW variables. The second (OP_1) adds a set of MMT-related variables, namely: (i) trip to Rome with or without stop-overs; (ii) transport mode used; (iii) other influencing factors.

Table 8 reports the results of the two models. Comparing the log-likelihood at convergence for each model (− 2209.93 for OP_0 and – 2188.99 for OP_1) suggests rejecting the null hypothesis that the two specifications are equivalent. This implies that OP_1 is more informative than OP_0 and, thus, MMT features play a significant role in explaining multimodality intentions.

The Akaike (AIC) and Bayesian (BIC) information criteria provide contrasting indications. In fact, using the former suggests OP_1 is better than OP_0 while using the latter advocates the opposite. Yet, considering that the augmented specification includes 11 additional parameters, the BIC score may be less reliable, as it tends to penalize complex models, where complexity refers to the number of estimated parameters (see, e.g., Konishi & Kitagawa, 2008).

Looking at demographic variable estimates, one notices that age, education, and occupation, in line with Le-Klähn & Hall (2015), are statistically significant in explaining MMW intention. On the one hand, people under 30 and those with better education have a higher intention

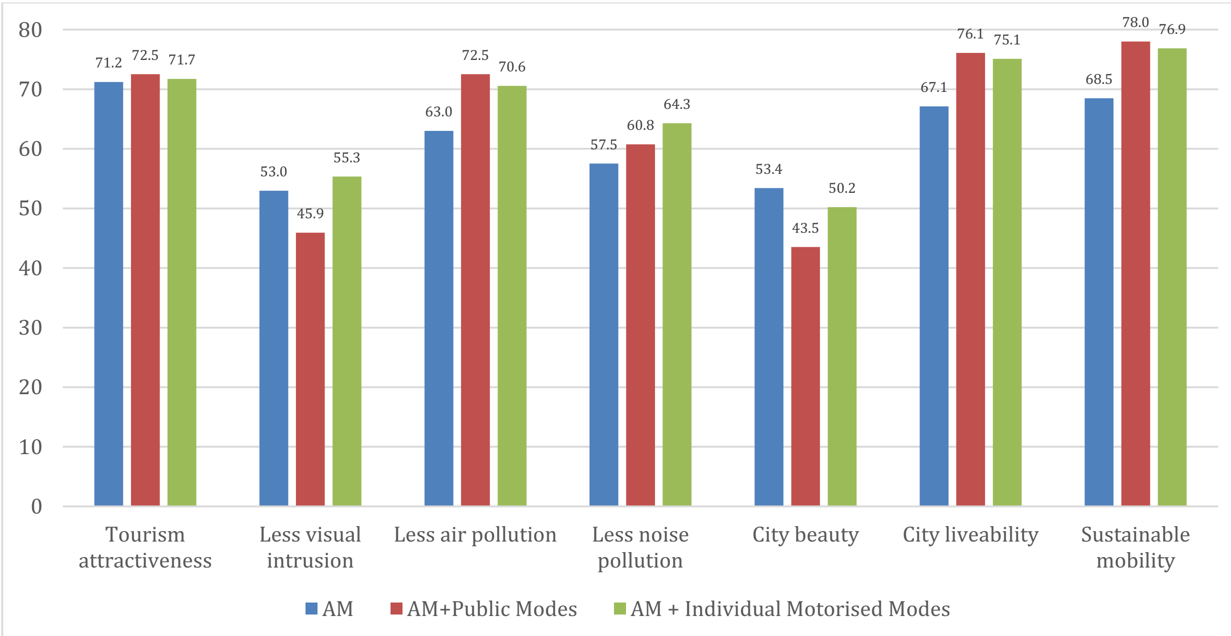

Fig. 5. - Cross-analysis of MMW benefits by mode choice (values in %).
Note: Independence scores (Pearson's chi-square tests, 2 df): Sustainable mobility, 9.0962, p = 0.011; City liveability, 7.7498, p = 0.021; City beauty, 11.3310, p = 0.003; Less noise pollution, 3.8986, p = 0.142; Less air pollution, 7.8423, p = 0.020; Less visual intrusion, 15.2629, p = 0.000; Tourism attractiveness, 0.2090, p = 0.901.

Table 7
– Tourists' intention to be multimodal within Rome.

	N	%
1 – Null	152	7.97
2 – Low	674	35.36
3 – Medium	725	38.04
4 – High	355	18.63

to be multimodal. Both being employed or belonging to higher income classes play a negative role with respect to the intention of being multimodal. Quite surprisingly, geographical variables (i.e., place of residence, relative location with respect to Rome) do not have a significantly role in explaining MMW intention. Tourists who own bicycles are predicted to use a diversity of transport modes at destination since they care about sustainability implications of mobility choices.

Travel and tourism-related issues are not overall relevant. The only exception, in line with Le-Klähn et al. (2015) and Le-Klähn et al., (2014), is the motivation for the visit, that also plays a role for tourists' modal choices. In more detail, tourists interested in visiting Rome inner city cultural heritage have a stronger intention to be multimodal compared to those attracted by extra-urban destinations. This might be due to the dense and more reliable LPT network within the city compared to sub-urban areas.

The number and type of perceived feasible transport modes play a statistically significant role. In fact, tourists perceiving using more than two transport modes feasible has a positive impact on the intention to be multimodal. Similarly positive is the conception of active modes and

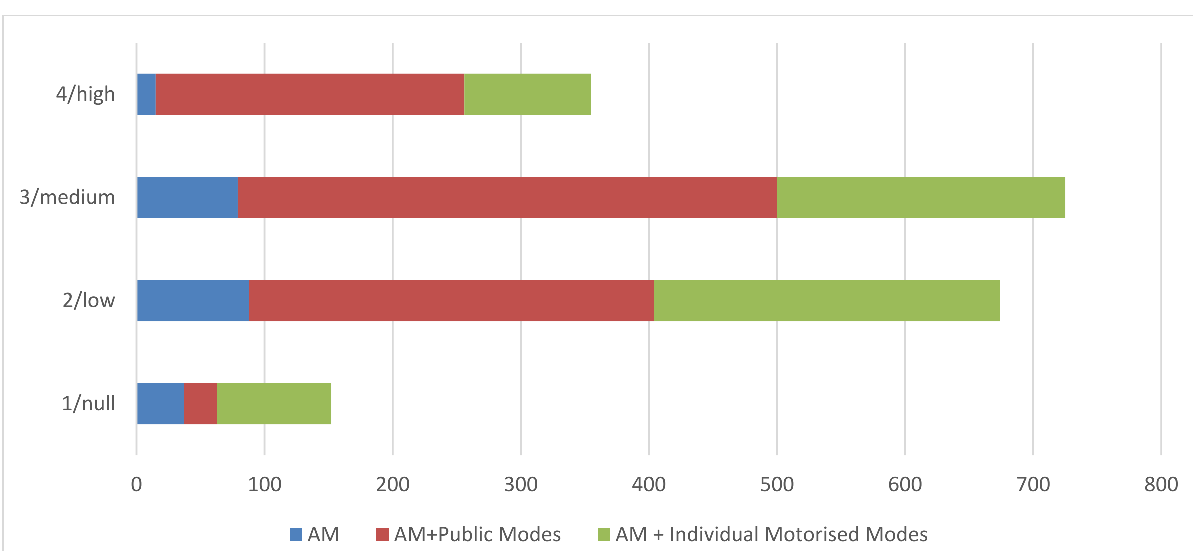

Fig. 6. - Cross-analysis of intention to be multimodal in Rome and MMW mode choices.
Note: Independence scores (Pearson's chi-square tests, 6 df): 136.3853, p = 0.0000.

Table 8
– Ordered probit model result.

Independent variables	MMW Rome Intention (dependent variable)				
		OP_0		OP_1	
		Coefficient	T-stat	Coefficient	T-stat
Demographic and mobility variables					
Gender	Baseline: Male				
	Female	0.02	0.41	−0.01	−0.02
Age	Baseline: Under 30				
	30 or over	**- 0.23****	−3.36	**−0.20****	−2.97
Education	Baseline: Primary/Middle school				
	High school	**0.24****	3.15	**0.24****	3.19
	Bachelor	**0.20***	2.23	**0.20***	2.22
	Master or PhD	**0.34***	2.13	**0.33***	2.05
Occupation	Baseline: Unemployed/Student/Retired				
	Employed	**- 0.15***	−2.41	**- 0.14***	−2.39
Residence	Baseline: Not a Province capital				
	Province capital	−0.01	−0.08	−0.01	−0.11
Region location	Baseline: South to Rome				
	North to Rome	0.08	1.10	0.06	0.80
Cars	Baseline: Not present				
	One or more in the household	0.08	0.51	0.11	0.71
Bicycles	Baseline: Not present				
	One or more in the household	**0.18****	2.61	**0.17***	2.46
Driving license	Baseline: Not present				
	One or more in the household	0.11	0.71	0.07	0.42
LPT subscription	Baseline: Not present				
	One or more in the household	−0.03	−0.63	−0.05	−0.1.00
Sharing subscription	Baseline: Not present				
	One or more in the household	0.08	0.81	0.08	0.83
Travel-related variables					
Length of stay	Baseline: Weekend or less				
	More than a weekend	0.06	1.12	0.06	1.17
Travel group	Baseline: Alone				
	In couple	0.14	0.89	0.06	0.38
	With friends	0.19	1.24	0.12	0.75
	With family members	0.13	0.86	0.06	0.41
Accommodation	Baseline: Friends or relatives' home, etc.				
	Hotel or B&B	−0.05	−0.82	−0.03	−0.60
Travel season	Baseline: Winter				
	Spring	0.05	0.46	−0.01	−0.04
	Summer	−0.08	−0.68	−0.10	−0.91
	Autumn	−0.02	−0.13	−0.06	−0.51
Travel motivation	Baseline: Extra-urban tourism				
	Urban tourism	**0.22*****	4.06	**0.21*****	4.00
Multimodality to Rome (MMT) variables					
MMT travel type	Baseline: Stop-overs				
	Direct trip	n/a	n/a	0.05	0.72
MMT modes	Baseline: Private car				
	Train	n/a	n/a	**1.71***	1.99
	Airplane	n/a	n/a	**1.61***	1.97
	Long-haul coach	n/a	n/a	1.36	1.57
MMT: drawbacks	Luggage handling	n/a	n/a	−0.03	−0.42
	Ticket fares	n/a	n/a	0.08	1.54
	Dwell times	n/a	n/a	0.06	0.87
	Interchange operations	n/a	n/a	0.10	1.75
	Tickets management	n/a	n/a	−0.10	−1.60
	Information management	n/a	n/a	−0.08	−1.21
Multimodality within Rome (MMW) variables					
MMW – number of modes perceived feasible	Baseline: Two modes or less				
	More than two modes	**0.30*****	5.12	**0.29*****	4.87
MMW – type of modes perceived feasible	Baseline: AM + Public modes				
	AM	**−0.51*****	−5.67	**−0.49*****	-5.51
	AM + Individual Motorised modes	**−0.34*****	−5.79	**−0.29*****	-4.83
MMW drawbacks	Luggage handling	0.01	0.26	−0.01	0.05
	Ticket fares	0.04	0.80	0.04	0.77
	Dwell times	−0.10	−1.73	−0.10	−1.62
	Interchange operations	0.01	0.24	0.01	0.05
	Tickets management	**−0.12***	−2.01	**−0.12***	-1.97
	Information management	**0.13***	2.12	**0.14***	2.21
MMW benefits	Sustainable mobility	−0.03	−0.45	−0.03	−0.50
	City liveability	**0.24*****	3.58	**0.25*****	3.59
	City beauty	0.01	0.06	0.01	0.03
	Noise pollution reduction	0.05	0.72	0.03	0.48
	Air pollution reduction	**0.28*****	3.70	**0.27****	3.54
	Visual Intrusion reduction	−0.01	−0.01	0.03	0.50

(*continued on next page*)

Table 8 (*continued*)

Independent variables	MMW Rome Intention (dependent variable)	OP_0		OP_1	
		Coefficient	T-stat	Coefficient	T-stat
	Tourism attractiveness	**0.19****	3.30	**0.17****	2.92
Threshold parameters					
Cut point k_1		−0.42	−1.39	1.12	1.27
Cut point k_2		**0.98*****	3.27	**2.54****	2.86
Cut point k_3		**2.15*****	7.13	**3.73*****	4.18
Goodness-of-fit measures					
Log-likelihood at convergence		- 2209.93		- 2188.99	
Number of parameters		38		49	
Akaike information criterion		4501.86		4481.98	
Bayesian information criterion		4729.52		4770.73	
Likelihood Ratio Test (LRT) for OP_0 nested into OP_1		$\chi2$ = 41.88, 11 df, p = 0.001			

Notes: "n/a" indicates that the corresponding independent variable is not included into the model specification. Statistically significant coefficients are in bold type. Significance level: *** = 1 %; ** = 5 %; * = 10 %.

LPT feasibility whereas the opposite is true when tourists consider feasible active modes and individual motorised modes. These considerations suggest that while there is an overall relevant connection, as expected, between the number of modes considered feasible and the intention to be multimodal, the sign of the impact this has depends on the specific types of mode combinations. In fact, considering feasible active modes and individual motorised modes reduces the estimated intention of being multimodal since this is mostly a "car-addicted" segment.

Among MMW influencing factors, tickets management issues have a negative impact on tourists' multimodality intention, and the opposite is true for reliable and comprehensive transport information. Information-related availability and comprehensiveness should be addressed when promoting MMW. This is in line with previous contributes from Gavalas et al. (2015) or, more recently, Briesner (2022) and Zamparini and Maltese (2021). Moreover, Dacko and Spalteholz (2014) underline the key contribution information provision might play in enhancing an intermodal behaviour. Kim et al. (2021) suggest that this is especially true for both LPT and MaaS where integrated travel information is crucial.

Perceiving liveability, air pollution reduction, and tourism attractiveness as possible MMW positive by-products have a positive impact on tourists' intention of being multimodal.

Focusing on OP_1, one discovers that travelling to Rome by either train or airplane (MMT modes) has a positive impact on the intention of being multimodal at destination. This is, most likely, due to the fact that, in this case, tourists do not have their own car available.

Table 9 reports the average marginal effects of MMT modes and MMW perceived feasible modes in both specifications. Including MMT modes (OP_1) does not provoke drastic changes with respect to the impacts MMW perceived feasible modes have on being multimodal at destination.

However, OP_1 sheds light on the impact using airplane and train in MMT has on MMW intentions. In fact, using airplanes, compared to cars, increases by 21.3 % the odds of being Medium (+17.5 %) or High (+38.8 %) MMW. Similar considerations apply for train that increases the odds (i.e., 18.6 % to 41.2 %) by 22.6 %.

These results, in line with Hergesell and Dickinger (2013) and Miravet et al. (2021), are of particular interest since they confirm the statistically robust relationship between MMT and MMW.

6. Discussion and conclusions

Policymakers have historically neglected the prioritization of MMW in tourism, despite its potential to significantly enhance sustainable tourist mobility at destinations. Similarly, research on multimodality within tourism mobility remains limited. To address these gaps, this study examines the multimodal travel intentions of Italian tourists during a hypothetical visit to Rome, offering novel insights into this underexplored subject.

The study identifies key factors influencing multimodal travel choices to aid service providers and policymakers in devising traffic management strategies applicable to Rome and similar urban tourist destinations. The findings indicate that younger, well-educated tourists, who arrive in Rome via public transport and exhibit a strong interest in cultural attractions, as well as environmental awareness, are more inclined towards multimodality. Therefore, tailored initiatives to promote MMW should consider tourist segmentation based on age, travel purpose, or mode of transport used to reach the destination, as also underlined by Park et al. (2023), Gutiérrez et al. (2020), and Tkaczynski et al. (2009).

To stimulate multimodality among less willing tourists, accessibility-focused strategies aimed at minimizing disruptions at transport interchange points could be effective. For older tourists with greater financial resources and flexibility to travel during off-peak periods, promoting multimodality can enhance inclusivity and help address tourism seasonality challenges. Similarly, integrated travel packages encompassing transport within the city and to peripheral attractions could stimulate interest and reduce congestion in central areas. This approach is especially critical ahead of major events like Rome's Jubilee in 2025, necessitating comprehensive tourism flow management plans.

Given the interplay between MMT and MMW, it is crucial to communicate options for multimodality broadly, multilingually, and well in advance. Linking this information to major carriers, offering

Table 9
- Average marginal effects – Comparison between models OP_0 and OP_1.

Baseline: AM + Public modes	OP_0				OP_1			
	Null/1	Low/2	Medium/3	High/4	Null/1	Low/2	Medium/3	High/4
AM only	0.071	0.114	− 0.069	− 0.116	0.070	0.109	− 0.068	− 0.111
AM + Private modes	0.043	0.082	− 0.041	− 0.084	0.036	0.069	− 0.033	− 0.071
Airplane	n/a	n/a	n/a	n/a	− 0.208	− 0.355	0.175	0.388
Train	n/a	n/a	n/a	n/a	− 0.221	− 0.377	0.186	0.412

Note: Only statistically significant marginal effects are displayed.

seamless ticket integration, and providing various fare options digitally or at key destinations would facilitate tourist mobility.

Encouraging tourists who arrive in Rome by car to adopt sustainable practices, such as parking their vehicles upon arrival and relying on LPT during their stay, could further support the city's mobility goals. This effort may be reinforced by campaigns promoting LPT use and advantageous parking rates, complemented by clear information on official tourism websites. Enhancing walkability and discouraging private vehicle use in central areas can also contribute to achieving these objectives.

Aligning with previous studies (e.g., Dacko & Spalteholz, 2014; Kim et al., 2021), collaboration between long-haul and local mobility providers is essential for offering integrated pricing, efficient ticket management, and comprehensive information dissemination. This comprehensive approach underscores the significance of intangible elements – like timely communication of service availability – over infrastructural factors in promoting multimodality. Developing multimodal hubs to facilitate active and electric/shared vehicle use further highlights the need for regulatory measures, education, business models, and effective procurement to integrate micro-mobility into urban systems, as also suggested by Arnold et al. (2023) and Attard and Balbontin (2024).

The findings of this study have implications for policymakers seeking to enhance tourist experiences through sustainable travel, potentially benefiting residents and boosting urban appeal. Effective governance, encompassing public-private partnerships across tourism and transport sectors, can facilitate innovative, tailored measures for various tourist segments, promoting sustainable and integrated transport solutions.

A first limitation of the study is that it investigates a hypothetical trip rather than a real one. Apart from the necessity potentially ascribable to any mobility restrictions imposed by the pandemic, as already explained in section 3, the choice was dictated by the possibility of giving respondents the opportunity to find travel related information easily and quickly on the Internet, even if they had not been to the Capital before (which, however, given the rather low average age, is still quite likely). In addition, the approach used in the questionnaire, based on the TPB, emphasised empirical evidence of a relationship between intention and actual behaviour, on the one hand, and, more upstream, between perceived feasibility and intention, on the other, which helped reducing perplexities on this aspect.

Another possible limitation of the survey refers to the fact that the concept of multimodality is anything but intuitive. In fact, despite the clear instructions in the questionnaire, most respondents, when asked to indicate all the means of transport used to reach Rome, basically mentioned only the main one. Therefore, they might have not considered those shorter distance trips (feeder transport) also needed to reach the air or rail hubs, which is consistent with the limited existing literature on the first and last mile of LPT-based travel such as reported in Venter (2020). Both high-speed trains and planes as well as long-distance buses/coaches are not so widespread in the urban area, which contrasts with the ubiquity of LPT stops or the maximum flexibility allowed by the car.

From a methodological point of view, it is interesting to note that multimodality can be deducted from modal choices, which makes it possible to overcome the obstacle posed by the lack of understanding of the questions asked. Therefore, having the declared data on the different transport choice options, it was still possible to reconstruct the actual intention to be multimodal. This is especially useful for the MMW, i.e., the use of more than one means of transport during the stay in Rome. It is interesting to note that, considering the answers given to the question on the number of means of transport perceived feasible to use during the stay in Rome, those who have an environmentally sustainable profile (not using individual motorised means of transport neither their own nor rented/shared), often do not perceive themselves as multimodal at their destination. In fact, the use of active mobility, even when exclusive, but especially when utilitarian (e.g., walking to the LPT stop), is not perceived as an additional mean of transport. A future study could address the attractions visited, from which one can infer the need to use one or the other means of transport, or a combination thereof, to reach them.

Another further investigation, which might be more feasible and interesting, especially in applying this type of analysis to a smaller and lesser-known city, should include the transport choices made by excursionists, which also impact on the city transport system.

To conclude, from the user perspective, one must recognise that promoting cultural changes in the population's perception of mobility towards MMW also generates more sustainable and responsible behaviours of targeted tourists choosing more eco-friendly transport options, when available, thus positively contributing to the environment. This can be crucial for destinations seeking to position themselves as sustainable. Indeed, orienting tourism policy towards greater sustainability not only mitigates the adverse effects of tourism on the destination, but also enhances the quality of life for all urban stakeholders, including tourists, residents, investors, and city users.

CRediT authorship contribution statement

Ila Maltese: Writing – review & editing, Writing – original draft, Visualization, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Daniele Crotti:** Writing – original draft, Validation, Methodology, Formal analysis, Data curation. **Edoardo Marcucci:** Writing – review & editing, Supervision, Conceptualization. **Valerio Gatta:** Writing – review & editing, Validation, Supervision, Conceptualization. **Luisa Scaccia:** Writing – review & editing, Validation, Supervision.

Declaration of competing interest

None.

We declare that there's no financial/personal interest or belief that could affect our objectivity.

To prevent ambiguity, we state explicitly that no potential competing interests exist.

Appendix A

Table A1
- Binary and categorical covariates.

Variable		Description
Demographics	Gender	Male = 0, Female = 1
	Age	Under 30 = 0; 30 and over = 1
	Education	Primary/Middle school*; High school; Bachelor; Master/PhD

(*continued on next page*)

Table A1 (*continued*)

Variable		Description
	Occupation	Unemployed/Student/Retired = 0; Employed = 1
	Residence	Not a Province (NUTS3) capital = 0; Province capital = 1
	Region location	South to Rome = 0; North to Rome = 1
Household Mobility	Cars	Not present = 0; One or more in the household = 1
	Bicycles	Not present = 0; One or more in the household = 1
	Driving license	Not present = 0; One or more in the household = 1
	LPT subscription	Not present = 0; One or more in the household = 1
	Sharing subscription	Not present = 0; One or more in the household = 1
	Length of stay	Weekend or less = 0; More than a weekend = 1
	Travel group	Alone*; In couple; With friends; With family members
Travel features	Accommodation	Friends or relatives' home, etc. = 0; Hotel or B&B = 1
	Travel season	Winter*; Spring; Summer; Autumn
	Travel motivation	Extra-urban tourism = 0; Urban tourism = 1
MMT Rome	Travel type	Stop-overs = 0; Direct trip = 1
	Train	No = 0; Yes = 1
Modal choice *towards* Rome	Airplane	No = 0; Yes = 1
	Long-haul Coach	No = 0; Yes = 1
	Private car	No = 0; Yes = 1
MMW Rome	Number of modes	1*, 2, 3, 4, 5 or more
Modal choice *within* Rome	MMW profile	AM; AM + Public modes; AM + Private modes

* = *categories used as baseline in the ordered probit modelling.*

Table A2
- Covariates related to subjective drawbacks and benefits of both MMT and MMW aspects.

Variable	Description
MMT and MMW drawbacks	Luggage handling
	Ticket fares
	Dwell times at stops/stations
	Interchange operations
	Tickets management
	Information management
MMW benefits	Sustainable mobility
	City liveability
	City beauty
	Noise pollution (reduction)
	Air pollution (reduction)
	Visual Intrusion (reduction)
	Tourism attractiveness

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