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An analysis of the link between high speed transport and tourists' behaviour

Abstract

The focus of this manuscript is on the analysis of the impacts of the High Speed Rail system in Italy on the tourism market. An analysis has been carried out for 77 Italian cities. Results show that the effects of High Speed on the number of tourists and the number of overnights spent at destination are positive in all the cities served by the High Speed Rail. On the other hand, other factors, such as the attractions at destinations and the Gross Domestic Product, affect tourists' choices for the case study of cities not served by the High Speed Rail.

Key words: tourism market; tourists' behaviour; overnights; high-speed rail; Italy

Introduction

The transportation industry is a global industry that meets the need for moving passengers and freight as efficiently as possible. It is often argued that a country with a good transportation system can be considered a tourist destination; for exampl, for Kaul (1985) transportation network is an essential component of successful tourism development. Khadarooa and Seetanah (2008, p. 831) agree with the principle that "*provision of suitable transport has transformed dead centres of tourist interest into active and prosperous places attracting multitudes of people*".

Over the centuries, the transport modes have been changing according to the development of technology and discovery and application of steam and electricity in the 19th century and the internal combustion engine in the 20th century. Since 1964, with the Shinkansen in Japan, the revolution in the transportation industry has been represented by High Speed Rail (HSR). The latter has recently experienced significant expansion and new projects all around the world are in the pipeline. Given that Europe is among the most visited continents in the world, HSR is likely to induce changes in tourist behaviour.

The objective of this paper is to investigate the relationship between the increase of accessibility brought by HSR systems and the tourism market in Italy. The case study was of the High Speed/High Capacity (HS/HC) Rail project. It should be conceived within the wider context of the Trans-European corridors. In Italy, the first HSR line was inaugurated in 1992 between Florence and Rome with the so called "Direttissima", which allowed trains to run at 230 km/h, covering the 254 km between Rome and Florence in about two hours (Cascetta, Papola, Pagliara & Marzano, 2011). However, this project dated back to 1970. The new generation of HSR (i.e. with trains running at 300 km/h) started in December 2005 between Rome and Napoli and Milan and Bologna. Later, in December 2009, the project was extended with the Milan–Turin and the Bologna– Florence lines. In 2010 the Italian HSR network was operational and other developments are still a work in progress. The station-to-station travel

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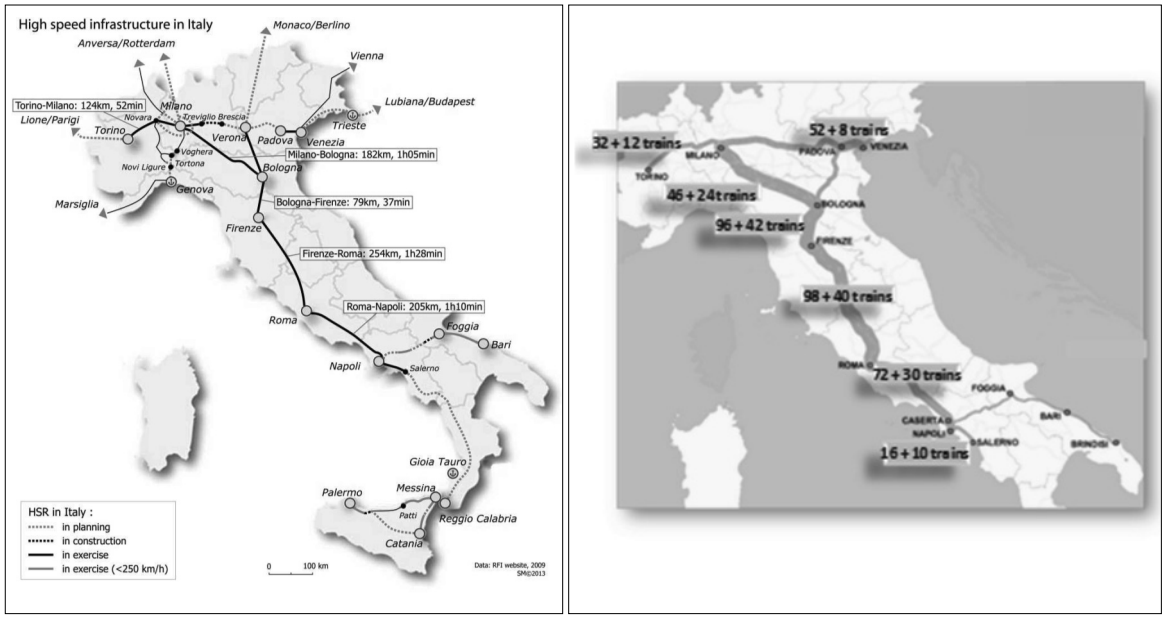
times, depending on the OD (origin-destination) pair, which have been reduced of about 20– 40%, are expected to further decrease with the new underground bypass stations in Bologna and Florence that will allow speeding up the service in dense urban areas. Once the whole HSR project will be completed, most major cities will be connected to the network. The network, shown in Figure 1 (left), is not "capillary", i.e. it serves only main cities and therefore the accessibility to them is very low for users living in more peripheral ones. In addition to the HSR lines, there are also the High Capacity (HC) rail lines (see Figure 1a), consisting in speeding up and increasing the capacity of the existing rail lines between Florence and Rome.

The national Italian network and operations are all owned by FS (Ferrovie dello Stato, i.e. the State Railway) Holdings, a fully government-owned company. It has three key operating subsidiaries: Trenitalia operates all freight and passenger trains, including the high-speed trains, RFI (Rete Ferroviaria Italiana) manages the infrastructure, and TAV (Treno Alta Velocità SpA) is responsible for the planning and construction of the new HS infrastructure. Since 2012, a new private company, NTV (Nuovo Treno Viaggiatori), is competing with Trenitalia on the same HSR network. The number of trains (i.e. the frequency) on each O-D connected section are reported in Figure 1b.

Figure 1
The high-speed/high-capacity rail system in Italy (the total number of trains along each corridor is reported considering the two operating companies Trenitalia and NTV)

a) High capacity rail lines **b) Train frequency***



*The total number of trains along each corridor by the two operating companies Trenitalia and NTV.
Source: Delaplace et al. (2014) adapted from RFI 2009.

Travel and tourism in Italy is expected to register a positive performance and continue to grow. Finally, the fact that travel is increasingly affordable, coupled with the attractiveness of the country, is expected to further improve the performance of the Italian tourism sector (Euromonitor, 2016).

The aim of the paper is to give an overview of the impacts of HSR on toursim in general and to estimate the impact of the Italian high speed rail system on tourism.

HSR and tourism: a literature review

The analysis and evaluation of the impacts of transport infrastructure on the tourism market is important for the administrations which aim at promoting this service. Indeed the introduction of a new transport infrastructure alternative needs the coordination of other factors like destination promotion, image, destination management and marketing on local tourism and community (Pagliara La Pietra, Gomez & Vassallo, 2015a; Pagliara, Mauriello & Garofalo, 2017). Several research papers deal with the link between HSR and the tourism market served by this system (Coronado, Garmendia, Moyano & Ureña, 2013; Mimeur, Facchinetti-Mannone, Carroue & Berion, 2013; Delaplace & Perrin, 2013; Bazin, Beckerich & Delaplace, 2013; Wang, Huang, Zou & Yan, 2012; Chen, 2013; Bazin & Delaplace, 2013, for a review). The link between tourists and accessibility can be modified by a HSR service (Delaplace, 2012) thanks to its power of shrinking space, i.e. its power of decreasing distance and, therefore, decrease travel costs. As a consequence, HSR can have an impact on the quality of tourist services and the competition between different destinations (Masson & Petiot, 2009; Pagliara, Vassallo & Roman, 2012). Wang et al. (2012) noted that some cities can benefit from a new HSR line while others cannot, beacuse they did not see any growth in the econommy. The effects of HSR on the tourism industry have been studied by using different methods. Among the qualitative approaches, ex post analyses demonstrate that the relationship between HSR service and tourism depends on the type of tourism. For example, in the paper by Bazin, Beckerich and Delaplace (2011), the impacts of HSR on urban and business tourism on French cities close to Paris have been analysed. The main outcome of the study is that urban tourism is generally a short-stay tourism. Therefore, using HSR avoids the fatigue of driving, congestion and parking difficulties in city centres. Then, during given periods of the year, especially with some promotional offers, HSR is cheaper than car when travelling alone or in couple. Finally, HSR is more comfortable and it can even save time when compared to air transportation, particularly when the rail station is placed in the city centre.

Among studies using quantitative methods for the analysis of the HSR, the work of Kuriharaa and Wu (2016) estimated the impact of the Shinkansen network extension on tourism development in Japan. They studied the change of tourism demand and tourist behaviour in Tohoku and Kyushu regions through an Ordinary Least Square regression analysis. The results show that tourism arrivals increased in cities connected by the extended Shinkansen network. The contribution of Chen and Haynes (2012) demonstrated that emerging HSR services (during the period 1999–2010) had significant positive impacts on fostering tourism in China. They use a multivariate panel analysis applied to 27 Chinese regions and confirmed that HSR can increase the competitiveness in tourism. Wang, Niu and Qian (2018) examined the characteristics and evolution of spatial patterns of the urban hinterland before and after HSR network in China, through an economic relation model and a spatial analysis in ArcGIS. The results showed that HSR strengthened tourism-based economic relationships between cities. Following the same methodological approach, Campa, López-Lambas and Guirao (2016) also estabilsehd an initial positive link between the increase in foreign arrivals and revenues and the HSR deployment in Spain.

However, a different contribution from Spain (Albalate & Fageda, 2016), showed a negative indirect effect of HSR on tourist growth, using three different econometric techniques. This result is probably attributed to the HSR network design which does not correspond to the ridership needs and which has a substitution effect on air transportation. This behaviour is confirmed in the paper by Albalate, Campos and Jiménez (2017), which, by combining both difference-in-difference and panel data techniques, found that the effects are, in general, extremely weak or just restricted to larger cities. Delpalace,

Pagliara and La Pietra (2016) specified regression models with the objective of studying the relationship between HSR and destination choice of theme parks, (i.e. Disneyland Paris and Futuroscope Parks), served by a HSR station. Revealed preference surveys were employed and the results diverge. In the case of Disneyland, tourists declared that the presence of HSR was fundamental in the choice of the destination; while in the case of Futuroscope, tourists declared that HSR was not relevant.

In the paper by Cartenì, Pariota and Henke (2017), the aim was twofold: to quantify the hedonic value of an HSR service related to a domestic tourist trip and to investigate the domestic tourist attractiveness of the main Italian cities, evaluating the attributes influencing the perception of a city as a domestic tourist destination. On the basis of a revelead and stated preference surveys, a binomial logit model was specified with serial correlation in residuals, estimating whether or not the cities in the panel were perceived as possible destinations for domestic tourist trips made by train. The estimation results showed that city-specific attractiveness attributes, like entertainment and restaurant rate, number of sites of interests and level of services variables, such as travel time and cost and HSR brand, influenced the perception of a city as a possible destination for a domestic tourist trip by train.

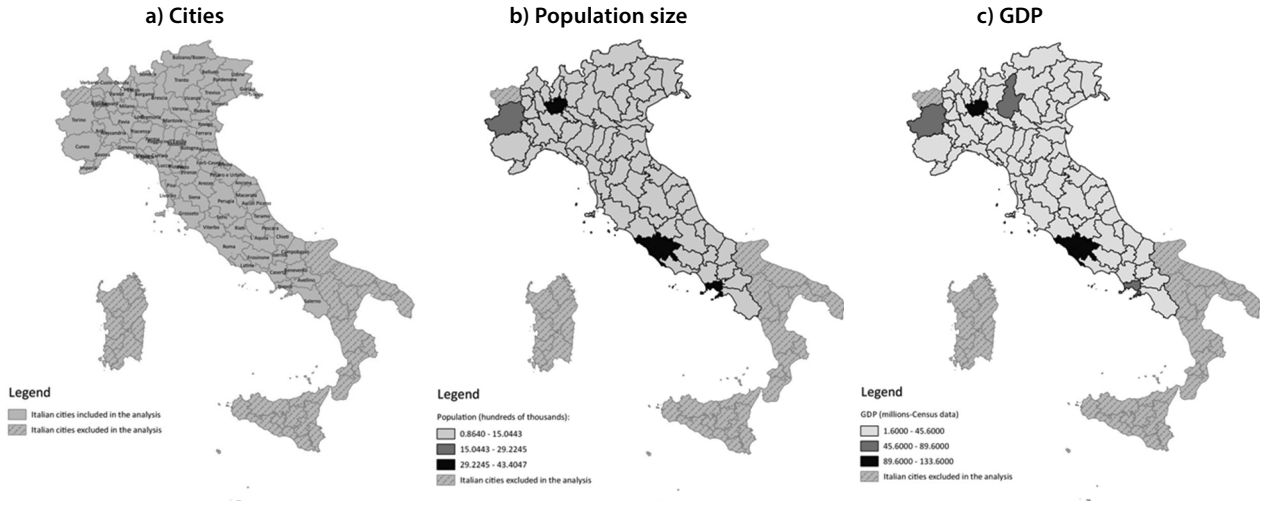
Another aspect of tourism is to study tourists' intention to revisit a given destination. Indeed, the increase in accessibility due to HSR deployment can foster the tourists´ intention to revisit a city. Seddighi and Theocharous (2002) analyzed the probability of revisiting Cyprus in terms of socio-demographic and destination characteristics. They developed a micro-econometric approach based on observations of holidaymakers. Barros and Assaf (2012) concluded that the probability of revisiting Lisbon increased significantly with accommodation range, events, food quality, expected weather, beach, overall quality, nightlife, reputation, and safety. Delaplace, Pagliara and Mermet (2014) and Pagliara, Delaplace and Vassallo (2014; 2015b) studied the factors influencing destination choice for tourism purpose and the role of HSR systems in affecting this choice to revisit Rome, Paris and Madrid. There are also contributions in the literature concerning the competition of HSR systems with other transport modes, such as car (Cascetta et al., 2011) and air transportation (Pagliara et al., 2012), highlighting that the mode shares are in favour of the new transport technologies.

The model proposed in this manuscript provides a contribution to the international literature since it introduces panel data regression models and demonstrates that HSR can affect tourists' choices.

Methods

The impacts of HSR projects on tourism can be quantified in different ways. In this study, an empirical analysis has been carried out with the aid of a dataset containing information, both, on tourism and transport for 77 Italian cities, during the 2006-2013 period. The number of municipalities considered are the main cities of the Italian regions excluding Basilicata, Puglia, Calabria, Sicilia and Sardinia, which did not experience any investment in HSR (see Figure 2a). In Figure 2b and 2c the population and the GDP of the 77 cities considered for this analysis are reported, in order to give an idea of their main socio-economic characteristics.

Figure 2
Cities included in the analysis and their main characteristics



Source: Istat (Italian Census - year 2013)

Two different datasets have been considered. One was made of 120 observations composed by cities served by HSR (15 cities x 8 years). The second one was made of 528 observations composed by cities not served by HSR (62 cities x 8 years).

The dependent variables were:

- *IT - tourists:* number of Italian tourists (visitors - hundreds of thousands from census data). This variable is split in two, considering the cities served and those not served by HSR;
- *Foreign Tourists*: number of foreign tourists (visitors - hundreds of thousands from densus data*).* This variable is split in two taking into account the two above samples;
- *IT-Overnights*: nights spent in tourism accommodation by Italian tourists (nights - hundreds of thousands from census data). This variable is split in two taking into account the two above samples;
- *Foreign-Overnights*: nights spent in tourism accommodation by foreign tourists (nights - hundreds of thousands from census data). This variable is split in two taking into account the two above samples.

The independent variables were:

- *HSR*: binary variable taking value 1 if HSR is available, 0 otherwise;
- *POP:* inhabitants (hundreds of thousands - census data);
- *HUB*: binary variable taking value 1 if the airport is a hub of a network carrier; 0 otherwise;
- *GDP*: is the Gross Domestic Product (millions - census data);
- *Unemployment*: % of unemployed in the province (census data);
- *Attract*: number of museums in a city (census data).

In this study, the dependent variables took only non-negative integer values. Count data have been modeled through the Poisson distribution, where the probability of a given city i having y_{it} number of tourist per year is given by (Washington, Karlaftis & Mannering, 2010; Pagliara et al., 2017):

$$P(y_i) = \frac{{\lambda_i}^{y_i} e^{-\lambda_i}}{y_i!} \quad (1)$$

where $P(y_i)$ is the probability of city i having y_i tourist per year and λ_i is the Poisson parameter for city i, which is equal to the expected number of tourist per year at city i, $E[y_i]$. Generalized Linear Models (GLMs) were considered to be the most suitable ones in order to determine the relationship between count data and the dependent variables (Agresti, 2002). The data considered involved measurements over time for the same cities, to avoid the serial correlation, the panel data regression models were used, since they allow modelling a wide variety of correlation patterns. To take into account these possible unknown correlations, an extension of GLMs was used, i.e Generalized Estimating Equations (GEEs) (Fitzmaurice, Laird & Ware, 2012). The significance of each variable was tested with the *t*-student statistic, therefore a coefficient was significant when *t* is greater than 1.96.

The model goodness of fit was measured by a simple extension of R^2 statistics for GEE models, namely $R^2_{marginal}$ (Zheng, 2000):

$$R^2_{marginal} = 1 - \frac{\sum_{i=1}^{T}\sum_{i=1}^{n}\left(Y_{it} - \hat{Y}_{it}\right)^2}{\sum_{i=1}^{T}\sum_{i=1}^{n}(Y_{it} - \bar{Y})^2} \quad (2)$$

where $\bar{Y}$ is the marginal mean across all the time periods $\frac{1}{nT}\sum_{i=1}^{t}\sum_{i=1}^{n} Y_{it}$ while $\hat{Y}_{it}$ is the predicted value. It has almost the same properties of R^2 used in regression models, with the exception that it can take values less than zero, when the estimated model predicting capability is not very good w.r.t. the intercept-only model. Moreover, it reduces to an R^2 measure when there is one measurement per panel with T = 1 (Ballinger, 2004).

Results and discussion

Considering the Italian tourists, the different behaviour can be observed for the cities served and not served by HSR (Tables 1 and 2). However, for both case studies, the variable *Attract* was significant and of the expected sign, meaning that the number of museums has an impact on the choice of a given destination. The variable *HSR* was significant only for the first case together with the presence of an airport hub.

Table 1
Italian tourists – cities not served by HSR

Variable	Coefficient (t- student)
Unemployement	-0.012 (-6.6)
Attract	0.550 (14.25)
Constant	2.293 (43.42)
No. of observations	528
R^2	0.36

Table 2
Italian tourists –cities served by HSR

Variable	Coefficient (t- student)
HSR	0.079 (11.78)
Unemployement	-0.011 (-7.16)
Attract	0.268 (8.21)
HUB	0.268 (2.85)
Constant	3.222 (37.30)
No. of observations	120
R^2	0.37

In contrast, the behaviour of foreign tourists was different where, in both cases, the *GDP* has an impact together with the variable *Attract* (see Tables 3 and 4). On the other hand, the variable *HSR* is again significant for foreign tourists choosing cities served by HSR.

Table 3
Foreign tourists - cities not served by HSR

Variable	Coefficient (t- student)
GDP	0.031 (10.54)
Attract	0.526 (9.23)
Constant	1.165 (13.19)
No. of observations	528
R^2	0.32

Table 4
Foreign tourists - cities served by HSR

Variable	Coefficient (t- student)
HSR	0,015 (8,69)
GDP	0,005 (22,14)
Attract	0,497 (18,89)
Constant	2,802 (34,34)
No. of observations	120
R^2	0.50

Concerning the number of overnight spent by the Italian tourists, for both cases of cities served and not served by the HSR (Tables 5 and 6), the variables *POP*, *GDP* and *Attract* had an impact, while again the variable *HSR* had an effect only on the number of overnights in the case of the cities served by the HSR.

Table 5
Overnights spent by Italian tourists - cities not served by HSR

Variable	Coefficient (t-student)
POP	0.070 (6.33)
GDP	0.013 (5.48)
Attract	0.729 (39.19)
Constant	3.576 (91.95)
No. of observations	528
R^2	0.49

Table 6
Overnights spent by Italian tourists: sample with cities served by HSR

Variable	Coefficient (t-student)
HSR	0.013 (3.73)
POP	0.008 (3.3)
GDP	0.009 (13.44)
Attract	0.439 (29.39)
HUB	0.456 (5.73)
Constant	4.590 (99.69)
No. of observations	120
R^2	0.36

In Tables 7 and 8, the number of overnights spent by foreign tourists is reported. In the case study of the cities served by the HSR, the variable *HSR* was significant and positive. The variables *GDP* and *Attract* had an effect in both cases.

Table 7
Overnights spent by foreign tourists - cities not served by HSR

Variable	Coefficient (t-student)
GDP	0.032 (5.22)
Attract	0.662 (4.91)
Constant	2.408 (7.40)
No. of observations	528
R^2	0.39

Table 8
Overnights spent by foreign tourists - cities served by HSR

Variable	Coefficient (t-student)
HSR	0.019 (5.38)
GDP	0.006 (8.46)
Attract	0.712 (7.61)
Constant	3.725 (9.51)
No. of observations	120
R^2	0.27

Conclusions

This paper has attempted to highlight the expected impacts of the HS/HC Rail project in Italy on the tourism market. An empirical analysis has been carried out in this respect with the aid of a database containing information on, both, tourism and transport for the Italian cities, during the 2006-2013 period. The models proposed highlight the different behaviour of the cities that are served by a HSR line with those that are not. Results show that the effects of HSR on the number of visitors, the number of nights spent at destination were positive in all the cities served by a HSR line. For cities not served by a HSR line, other factors were significant and haf an impact on tourists' choices, such as the number of museums and the GDP.

This result is in line with the current results of similar studies on the topic. Indeed, there is a growing literature on the analysis of the effects of HS transportation on the economy of a country. One example is represented by tourism which increases mobility among nations and enriches a sharing culture. Moreover, by generating income flows as a key component of the service economy, tourism acts as an economic catalyst for many cities and regions, able to redistribute wealth between regions. These issues should be addressed from the perspective of planning and management of HSR services, in terms of the different types of cities, regions, and destinations they serve with respect to the different types of flows they can foster.

One of the main limitations of the research proposed concerns the data set. Indeed further perspectives should consider the collection of more recent data, till 2017, and the introduction of the main cities of the Italian regions Basilicata, Puglia, Calabria, Sicilia and Sardinia regions, which have been excluded in this manuscript. Indeed they have not been considered in this analysis since they did not experience any investment in HSR, but they can be definitely included in the dataset of the cities not served by HSR. Specifically, it will be interesting to test if the same behaviour is kept or if changes are present. Another potential research direction concerns the use of additional data sources to infer the attractiveness of cities by exploiting Volunteered Geographic Information (VGI) and social network, such as Trip Advisor.

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