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An analysis of the competition that impinges on the Milan–Rome intercity passenger transport link

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ABSTRACT

This paper presents a simulation based on the discrete choice model, and a limited set of data to analyse the passenger market on the Milan–Rome intercity transport link. Considered in the analysis are market shares of both incumbents and new entrants, as well as consumer surplus and environmental costs. The link, which is the second largest intra-European connection, has been characterized by a low degree of competition in both rail and air transport services. The entry of new rail and air operators in 2012, however, will likely reshape market characteristics. The current paper argues the following: (i) most of the benefit in consumer surplus will stem from the introduction of competition in high speed rail; (ii) increased connections will result in increased environmental costs, which will partially offset the larger consumer surplus; and (iii) a reduction in the difference between airline and rail companies involving the costs of infrastructure access and security could lead to more fair forms of competition between airline and rail companies, but it generates a worst environment state.

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1. Introduction

Research by Derudder and Witlox (2005) identifies the Milan–Rome link as the fifth most important air route in the world in terms of total passenger flows, and the second most important in Europe by the same metric, carrying 2,471,007 passengers in 2008 (Eurostat, 2012). Despite the economic relevance of the link, competition has been moderate at best. In the period from 1995 to 2009, for example, only two airlines (Alitalia and AirOne) flew between Milan and Rome. The bankruptcy of Alitalia in 2009, and its merger with AirOne, however, provided the new company with monopoly power. The new Italian airline, named Compagnia Aerea Italiana (CAI), is now the only operator on the route. By October 2012, as a consequence of the interventions of the Italian antitrust authority Agenzia Garante per la Concorrenza ed il Mercato (AGCM), additional airlines will now have access to the route[1].

Importantly, the Milan–Rome link represents the first case of high-speed rail competition in Europe. In fact, in April 2012, the incumbent operator, Trenitalia (TI), will start to compete with a new private rail company, Nuovo Trasporti Viaggiatori (NTV).

Another interesting aspect of the Milan–Rome link involves the difference that exists, in Italy, between the costs of both infrastructure access and security incurred by airlines and those incurred by rail companies. In fact, most of the costs of high-speed rail infrastructure development are covered, nationwide, by ordinary taxation (Giuricin, 2009). As a consequence, the costs of access to Italian high speed rail are relatively low when compared to those of other European countries (Giuricin, 2009).

Most of the literature on the Italian public transport industry has focused on the airport system (Abrate and Erbetta, 2010; Barros and Dieke 2008; Curi et al., 2008, 2010, 2011; Gitto and Mancuso 2012a, b; Scotti et al., 2012; De Nicola et al., 2013), the national airline company (Bergamini et al., 2010; Beria et al. 2011), as well as the national rail operator (Mancuso and Reverberi, 2003). In recent years, the importance of high speed rail has been investigated e.g., Ben-Akiva et al. 2010, Campos de Rus 2009, Cascetta and Coppola 2011 and Cascetta and Coppola 2012.

Despite these developments, an analysis of the competition between high speed trains and airlines (*inter-modal competition*) in Italy has not been previously attempted (Adler et al., 2010; Behrens and Pels 2012, Ivaldi and Vibes, 2008). The current paper thus directs itself to this line of research. The methodological approach used is in line with that proposed by Ivaldi and Vibes (2008) to analyze the air and rail competition on the Cologne–Berlin link in Germany; and, more recently employed by Prady and Ullrichz (2010) to describe the competition in freight transport on the trans-alpine link between France and Italy.

The earlier methodology has been modified here in order to determine the reference price related to a given transport service whenever (only) the minimum and maximum prices for that service are available. Moreover, for the first time, the environmental costs

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[1] AGCM, case no. C9812B, 22th February 2012.

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associated with selected market configurations are accounted for under both intra- and inter-modal competition scenarios. Finally, from a regulatory perspective, the paper offers a series of observations on the effects of taxes on fares under a competitive air–rail environment on the Milan–Rome link.

The paper is organized as follows: the next section describes the proposed model, while Section 3 discusses the relevant market and data needed for calibrating the model. Section 4 outlines results of the study's simulations, with Section 5 presenting selected discussion and conclusions.

2. The proposed methodological framework

Estimations of partial equilibrium models in markets with product differentiation have been undertaken a variety of studies, including those by Berry (1994), Besanko et al. (1998), Ivaldi and Vibes (2008), and Prady and Ullrichz (2010). In this framework, the discrete choice model (Anderson et al., 1992; McFadden, 1981; Ben-Akiva and Lerman, 1985; Ben-Akiva and Abou-Zeid, 2007; Train, 2007; Ortuzar and Willumsen, 2001; Cascetta and Papola, 2001; Cascetta, 2009; Cascetta and Papola, 2009), begins with available information on prices and product attributes on the demand side. Further, assuming a Bertrand-Nash equilibrium on the supply side, one is able to obtain estimates of demand and cost parameters for a broad class of differentiated, product-based oligopolistic markets.

In what follows, we consider two main categories of passenger business and leisure who may choose amongst four travel alternatives on the Milan–Rome transport link: by train, airplane, automobile, or no travel at all. With the exclusion of travel by automobile, the other two modalities can be utilized by more than one operator.

Without losing generality, the proposed mathematical formulation involves only a single market, either business or leisure, and assumes the presence of J transport companies, any of which can be an airline, a train company, or both. Thus, for consumer i ($i=1, 2,\ldots,n$) corresponding to the j possible transport alternatives ($j=1,2,\ldots,J$) offered in the market, the utility function of Berry (1994) becomes

$$U_{ij} = V_j + \varepsilon_{ij} \quad (i = 1, 2, \ldots, n; j = 1, 2, \ldots, J) \tag{1}$$

where V_j is the mean utility level common to every passenger utilizing transport mode j; and ε_{ij} is the random component representing the difference between consumer i's utility from the mean utility level of all passengers utilizing transport mode j.

Then, under the assumption of a logit demand model, the random component defined by (1) can be decomposed as follows:

$$\varepsilon_{ij} = \sigma \nu_{ig} + (1-\sigma)\nu_{ij} \quad (g = 1, 2, 3; i = 1, 2, \ldots, n; j = 1, 2, \ldots, J) \tag{2}$$

where g indicates the transport mode: $g=1(air)$, $2(car)$ *and* $3(train)$; ν_{ig} and ν_{ij} are, respectively, random components with a standard extreme value distribution; and $\sigma \in [0,1]$ is a parameter that measures the degree of relationship between alternatives j of transport mode g. A value of σ close to 1 implies that passengers place greater value on the mode of transport than they do on the alternative providers present in each mode group. In such a case, competition between alternative transport modes (inter-modal competition) is more fierce than is competition amongst those service providers within the same transport mode (intra-modal competition). The mean utility level in (1) can then be expressed by (3)

$$V_j = \psi_j - hp_j \quad (j = 1, 2, \ldots, J) \tag{3}$$

where p_j is the market price for alternative j ($j=1,2,\ldots,J$); $h>0$ is the marginal utility of cost saving for a given passenger; and Ψ_j is the aggregate measure of quality, which is expressed as a weighted sum of observable characteristics m_{jk} ($j=1,2,\ldots,J$; $k=1,2,\ldots,K$) in accordance with (4):

$$\psi_j = \sum_{k=1}^{K} m_{jk} \quad (j = 1, 2, \ldots, J) \tag{4}$$

now, consumer i chooses alternative j whenever the associated utility satisfies

$$U_{ij} \geq U_{ij'}, \quad \forall g(g = 1, 2, 3) \forall j \neq j' (j, j' = 1, 2, \ldots, J) \tag{5}$$

following the procedure proposed by Berry (1994), which is based on the hypothesis that the choice probabilities of the j alternatives can be proxied by their corresponding market shares, the mean utility level defined by (3) can be rewritten as (6)

$$\ln(s_j/s_0) = \psi_j - hp_j + \sigma \ln s_{j/g} \quad (g = 1, 2, 3; j = 1, 2, \ldots, J) \tag{6}$$

where s_j, $s_{j/g}$ and s_0 are, respectively, the total market share of alternative j, the market share of alternative j with respect to transport mode g, and the market share of non-travelers. Mathematically, the three market shares are given by the following functions:

$$s_j = s_g s_{j/g} \quad (g = 1, 2, 3; j = 1, 2, \ldots, J) \tag{7}$$

$$s_{j/g} = \frac{e^{V_j/1-\sigma}}{D_g} \quad (g = 1, 2, 3; j = 1, 2, \ldots, J) \tag{8}$$

$$s_0 = \frac{1}{\sum_{g=1}^{3} D_g} \tag{9}$$

where $D_g = \sum_j e^{V_j/1-\sigma}$ is the demand for transport mode j. From (7)–(9), we generate the price elasticities of demand given by (10):

$$\eta_j = \frac{dq_j}{dp_j}\frac{p_j}{q_j} = hp_j\left(s_j - \frac{1}{1-\sigma} + \frac{\sigma}{1-\sigma}s_{j/g}\right) \quad (g = 1, 2, 3; j = 1, 2, \ldots, J) \tag{10}$$

In order to determine the parameters, h and σ, (10) can be simplified as follows:

$$\eta_j = a(p_j s_j - p_j) + b(p_j s_{j/g} - p_j) \quad (g = 1, 2, 3; j = 1, 2, \ldots, J) \tag{11}$$

where $h=a$ and $\sigma=b/(a+b)$. Then, a and b are determined by ordinary least squares (OLS) on the available J observations. It is worthwhile to note that the limited number of observations, related to the J transport alternatives do not allows for a statistically significant inference on the parameters of (11).

Once h and σ are calculated, the following elements can be computed (for further details, see Ivaldi and Verboven, 2005):

The inter-modal price elasticities:

$$\eta_{jj'} = \frac{dq_j}{dp_{j'}}\frac{p_{j'}}{q_j} = hp_{j'}s_{j'} \quad (j \neq j', j \notin g, j \notin g); \tag{12}$$

The intra-modal price elasticities:

$$\eta_{jj'} = \frac{dq_j}{dp_{j'}}\frac{p_{j'}}{q_j} = hp_{j'}s_{j'}\left(\frac{\sigma}{1-\sigma} \times \frac{s_{j'/g}}{s_{j'}} + 1\right) \quad (j \neq j', j \notin g); \tag{13}$$

The marginal cost

$$\frac{p_j - c_j}{p_j} = -\frac{1}{\eta_j} \Rightarrow c_j = p_j - \frac{1-\sigma}{h(1-\sigma s_{j/g} - (1-\sigma)s_j)} \quad (g = 1, 2, 3; j = 1, 2, \ldots, J) \tag{14}$$

and, the consumer surplus:

$$CS = \frac{1}{h}\ln\left(\sum_{g=1}^{3} D_g^{(1-\sigma)}\right) \tag{15}$$

The remaining elements determined in the algorithm include the passengers' valuations related to selected components of the quality variable, ψ. In accordance with (4), the impact of a set of

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