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The effects of airline and high speed train integration

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ABSTRACT

With a theoretical model we analyze the social and environmental effects of airline and HST integration in two different scenarios: airports with capacity constraints and airports with low airline competition. The merits of this theoretical model are twofold. First, the model allows us to support and qualify some of the empirical predictions made by the literature that studies airline and railway integration. Second, the model can provide some insights to policy makers in order to evaluate the possible effects of airline and HST integration in alternative hypothetical situations. We use the Madrid–Malaga route (Spain) to highlight the potentials of the model to evaluate the benefits of airline and HST integration.

1. Introduction

High speed trains (HSTs) and airlines have been traditionally considered as alternative modes of transport in competition with each other. Indeed, due to both the possibility of moving passengers from city centre to city centre and the shorter travel time, the high-speed rail transportation has become particularly competitive on routes under 600 km in length or one hour flight (Givoni, 2005).[1]

Despite the undoubted advantages that competition generally has on social welfare, airline and HST integration may also be welfare enhancing. Indeed, since 2001 the European Union has recognized the positive effects of airline and HST integration, stating in its White Paper that *"network planning should therefore seek to take advantage of the ability of HST to replace air transport and encourage rail companies, airlines and airport managers not just to compete, but also to cooperate"* (Commission of the European Communities, 2001, p. 53; Givoni and Banister, 2006).[2]

One of the main arguments in favor of the integration of airline and HST refers to the release of slots at some major airports with capacity constraints (Givoni and Banister, 2006). As Givoni (2007b) points out freed capacity has an economic value. According to The Observer (2004): "Britain's national carrier has a market value of £3.2[€4.8] billion but it also owns 40% of the landing and take-off slots at Heathrow, which could be worth up to £2.5[€3.75] billion".[3]

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[1] Although several authors set different thresholds on the distance for which the HST loses its advantage over aircraft (Pavaux, 1994; Buchanan and Partners, 1995; Janic, 2003; De Rus and Nombela, 2007; Vickerman, 2009), most authors agree that the HST is no longer competitive for distances above 800 km in length (Commission for Integrated Transport, 2004; Givoni and Banister, 2007).

[2] The benefits of greater integration of the modal networks (airports, ports, railway, metro and bus stations) has been also highlighted in 2011 White Paper (Commission of the European Communities, 2011).

[3] The possibility of substituing flights by rail transportation under severe circumstances caused by temporary events is also a potential benefit of airline and HST integration. By introducing this possibility, an airline's hub-and-spoke network becomes a network with two sets of links: one flying between spoke airports and the hub airport with short travel time but possible delays caused by the insufficient capacity at the hub airport, and the other using the HST to transport passengers between spoke airports and the hub with longer transportation time but no delays because this mode does not require airside scarce resources (see Zhang and Hansen, 2008, for an analysis about this point).

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Another argument refers to airline and rail integration as an environmentally friendly way to avoid short-distance feeder flights (Grimme, 2007). Recent research has shown that the environmental damage of the HST is particularly acute in the construction phase (Kageson, 2009). However, once the infrastructure has been constructed, the HST seems to have an environmental advantage over air transport. In general, the plane is considered a mode of transport more harmful to the environment than HST, especially in regard to its impact on climate change. Givoni (2007a) examines empirically the level of air pollution and climate change impact of air and HST travel between the cities of Paris and London. He concludes that replacing a seat on a plane by a seat on a HST is always beneficial from the environmental point of view. Other studies such as Eurocontrol (2004) and Schreyer et al. (2004) confirm these findings. Moreover, taking into account the effects of airline and HST integration on airport congestion and the environment, Givoni and Banister (2006) estimate the benefits of airline and railways integration at Heathrow airport. The authors conclude that on HST routes of under 600 km in length, where the HST route is not more than 20% longer than the aircraft route, and the average HST speed along the route is at least 250 km per hour, the operation of airline and railway integration is beneficial for the airlines, passengers and the environment.

This article contributes to the literature on multi-modal transportation networks by developing a theoretical model, which aims to analyze under what circumstances the integration between HST and airlines may be beneficial.[4] The merits of this theoretical model are twofold. First, the model allows us to support and qualify some of the empirical predictions made by the literature that studies airline and railway integration (Givoni, 2005, 2007a,b; Givoni and Banister, 2006, 2007; Grimme, 2007), providing a theoretical background to explain the differences in authors' predictions. Second, the model developed in this paper can offer some insights to policy makers in order to evaluate the potential effects of airline and HST integration in alternative hypothetical scenarios. As an example, we follow the Madrid–Malaga route (Spain) to highlight the potentials of the model to evaluate the benefits of airline and HST integration. We support our exposition with some results from the cost-benefit analysis made by Alonso and Betancor (2011) to evaluate the consequences of intermodal agreements in the Madrid–Malaga route.

In particular, this paper examines, on the one hand, the effects of airline and HST integration on the environment and social welfare at airports with capacity constraints. On the other hand, this article analyzes the effects of airline and HST integration on the environment and social welfare at airports with low competition between airlines. In both cases, it is argued that airline and HST integration implies gains from the private point of view, while it may also have gains from the social and/or environmental perspective. In particular, we show that, compared with the case in which there is no capacity restriction, airline and HST integration is more likely to be welfare enhancing if the airport is capacity-constrained. Note that, in both cases that we analyze, modes complement each other but also, mode substitution takes place. Although mode substitution (due to integration) reduces competition and consumer surplus in domestic markets, if the airport is capacity-constrained, airline and HST integration allows the airline to release slots and satisfy demands that were unsatisfied. Because a higher global demand is satisfied after integration, at capacity-constrained airports, airline and HST integration is less likely to be environmental beneficial. For airports with low airline competition, we show that airline and HST integration may result in a tool to impulse greater competition, lower prices, more variety for consumers and, therefore, higher social welfare. However, given that lower prices imply a higher demand for travel, if the increase in the number of passengers by air in a certain route exceeds the corresponding decrease in the route where the HST operates, the effect of airline and HST integration on the environment could be negative.

Throughout the paper we follow the definitions proposed by Givoni and Banister (2006). In particular, Givoni and Banister (2006) differentiate between two concepts: cooperation and integration. Cooperation defines a situation where two modes are complementary, as both need to be used in order to travel from the origin to the destination, but there is no a formal agreement between the service providers of each mode. Under integration the aircraft and HST services are provided as "one complete journey with a fast and seamless transfer between the modes". From now on we refer to airline and HST integration maintaining this definition.

The rest of the paper is organized as follows. Section 2 reviews some theoretical models of airline and railway competition in the literature. Section 3 discusses the empirical evidence of airline and railway integration and introduces the analysis for the Madrid–Malaga route. Section 4 develops a theoretical model of airline and HST integration in two different scenarios. First, in subsection 4.1 we study the effects of airline and HST integration in airports with capacity restrictions. Then, in subsection 4.2 we analyze the effects of airline and HST integration on airline competition. Finally, Section 5 discusses the results and presents some general conclusions. All the proofs are relegated to Appendix A.

2. Theoretical models of airline and railway competition

Air and rail transport have been usually considered in the economic literature as alternative modes of transport in competition with each other (see, for example, Bel, 1997; Janic, 2003; González-Savignat, 2004; López-Pita and Robusté, 2004; Clever and Hansen, 2008; or Bilotkach et al., 2010).[5] In particular, most theoretical models in the literature assume that airlines and railways compete in differentiated products. The analysis of travel behavior is typically disaggregated, meaning that the

[4] Some of the papers dealing with other multi-modal transportation networks include: Basso and Jara-Díaz (2012) with networks composed by car and bus, Mishra et al. (2012) with networks of bus, metro and light rail, and Diana (2012) for networks with car and urban bus, trolleybus and tramway.

[5] Competition between modes of transport is a relevant issue in the literature. See, for example, Van Exel and Rietveld (2009) for an analysis of mode substitution between car and train.