Is the High-Speed Rail delivering on its promise? the intermodal competition with motorway transport in Spain

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1 Introduction

Spain has the largest High-Speed Rail (HSR) network in Europe, and in per capita terms, the largest in the World [1]. The deployment of such network was aimed to increase social cohesion across mainland Spain through enhancing access to their province's capitals. In this sense, HSR provides a cleaner way of transportation that competes with more polluting options, such as motorway and air transport, for the same route. The cleaner HSR technology has not passed unnoticed for the European Commission, which has financially supported the HSR deployment in Spain (and Europe), as stated in its Sustainable Mobility Strategy policy ([2]). However, for this policy to work, there should be an actual inter-modal substitution from more polluting modes of transportation to the HSR. This paper sheds light on this relation by analyzing the impact of HSR on motorway transport.

Most of the literature on the impact of HSR has focused in its relationship with air transport ([3], [4]. [5] [6]). This is not a surprise, since HSR has been regarded as a competitive mode of transport at medium and long distances. However, HSR also competes with motorway transport at medium distances [7], and the few studies available have focused only on analyzing the impact of the HSR on a single route ([8], [9], and ([10]), and in general, have not employed quasi-experimental methods. Our paper takes a comprehensive approach and analyzes, in a quasi-experimental setting, the causal impact of new HSR routes openings on motorway transport in Spain. Unlike previous studies, our paper analyzes the whole HSR network and not just one single HSR route. This meant a significant effort in gathering information on different variables since some years before the inauguration of the first HSR route, in 1992. As far as we know, besides [11] for the case of Italy, this is the first study that takes this comprehensive approach to analyze the intermodal competition between HSR and motorway transport for the case of Spain. Moreover, we complement the long-run analysis (which uses annual data from 1988-2019), with a short-run analysis (using monthly data from 2011-2019) to dig further into the very short-run dynamic of this relationship.

2 Data

There are several sources of information that will allow us to test if the openings of new routes of HSR caused an effect on motorway transport. First, we gather information on light-vehicle traffic from the whole highway network in Spain. In particular, the Transport Authority reports the average daily traffic from different traffic cameras spots (hereafter, tcspot) within a particular highway. We used the geo-referenced location of those tcspot to located them in maps that jointly with the Google Maps API, allow us to determine Origin-Destination routes that will be later mapped into treatment-control group, according to the openings of HSR routes. This information reported by the Transport Authority is available at the annual and monthly frequency. We also gather information on several other variables that will be used as control, all of them at the provincial or municipal level. For instance, we have information on the GDP at the provincial level, the population at the municipal level, weather conditions (precipitation, temperature, visibility, etc.), Furthermore, we also gather information that allows us to control for cost variables, as the price of gasoline, and highway's tolls.

3 Method

In our initial setting, we are starting our analysis with a Generalized Difference-in-Difference framework, in particular, we aimed to estimate:

$$ln(IMD)_{it} = \beta_0 + \beta_1 HSR_{it}^{Opening} + \gamma X_{g(i)t} + \alpha_i + \delta_t + \epsilon_{it} \quad (1)$$

where IMD_{it} is the average daily traffic in tcspot i in the year t; *HSR* is an index variable that groups the tcspot that have potentially been affected as a result of the opening of a new HSR route; X is a matrix of time-varying control variables as population, economic activity, weather, and cost indicators; α_i and $delta_t$ are individual, and time fixed effects.

The main threat to identification is due to the potential endogeneity coming from the non-random location of HSR routes. In particular, this is true if the choice to open the new HSR segment is influenced by unobservable factors that affect both, the location of the HSR and the highways traffic for that segment. We performed several robustness checks to show that the parameter of interest is conditionally exogenous to the relation. Moreover, we are exploring different alternatives to strengthen our results with the new econometric literature that accounts for a different sources of bias in Two-way Fixed Effects (e.g. [12], [13], among others)

4 Expected results

Although HSR seems to be a good policy for promoting cleaner transportation within medium-run distances, its success relies on the fact that individuals truly substitute motorways for HSR transport. We would expect to find no general effect of this substitution since the low frequency in which the HSR operates in some routes is a symptom of low occupancy. However, for some selected routes, we would expect that the HSR has had an impact on motorways transport.

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