

## **Measuring the Impact of High-Speed Rail on the Spatial Economy: Evidence for Spain**

Patricia C. Melo, Daniel J. Graham, Ruben Brage-Ardao  
Centre for Transport Studies  
Department of Civil and Environmental Engineering  
Imperial College London  
London SW7 2AZ

### ABSTRACT

During the period between 2000 and 2010 Spain has carried out the largest High Speed Rail (HSR) construction programme in Europe. During this decade four new corridors opened between 2005 and 2010, in addition to the Madrid-Seville HSR line which had opened in 1992. As a result, in 2010 the Spanish HSR network became the largest in Europe exceeding early HSR adopters such as France and Germany (UIC, 2010).

One of the main statements justifying the construction of the HSR network was to link all the peninsular capital cities with a HSR line. By 2020, it is planned that 90% of the country's population will live within a 50 kilometre radius to the nearest HSR station leading to outstanding ratios of HSR line kilometres per capita and per land size. The main assumption underlying this allocation of public resources to HSR has been its alleged positive impact on the economy. In this paper we conduct empirical analyses aimed at testing the validity of this hypothesis by looking at different aspects of economic performance, namely, (i) output growth, (ii) job creation, (iii) firm births, and (iv) firm deaths.

There are several reasons to assume why transport investment in HSR can make a positive contribution to economic performance. First, HSR can link distant markets and foster agglomeration economies, hence stimulating competition and increasing productivity (Graham, 2007). This enlargement in market scope can produce a wide range of benefits to firms related to: (i) the ease of access to a pool of skilled workers, made possible through improvements in the efficiency of commuting flows (labour market pooling, matching); (ii) the communication and sharing of ideas between firms and workers (knowledge spillovers, learning and sharing); (iii) the ease of access to customers and suppliers, including specialized professional services (input-output linkages, sharing, and learning) (e.g. Rosenthal and Strange, 2004; Duranton and Puga, 2004).

We use panel data at the provincial level (47 provinces) for the period between 1985 and 2010. Data regarding economic output were obtained from the Regional Account Series (Series de Contabilidad Regional) developed by the Spanish National Statistics Office (INE, Instituto Nacional de Estadística). It offers total and sectorial gross value added data. Data for firm births and deaths comes from the Companies Central Directory (Directorio Central de Empresas) which disaggregates industrial establishments by industrial activity, province and number of workers. This has helped us determine the influence of HSR in business location, through business creation, destruction, and relocation. Data for average labour force educational attainment, employment and unemployment rates are obtained from the Human Capital Series published by the IVIE (Instituto Valenciano de Investigaciones Economicas).

We have carried out an *ex-post* analysis to quantify how HSR has influenced economic output, job creation, and firm location (births and deaths) at the provincial level. We develop a causal analysis based on Difference-in-Differences (DID) methods. The DID method is a causal inference technique commonly used to assess the impact of a given innovation or policy change (called treatment) on a given set of outcomes. To implement the DID approach data are needed for two groups - *treated* and *control* - and two periods - *before* and *after* the treatment occurred. The treated group consists of the individuals who are exposed to the specific treatment (here a high-speed rail line) in one time period, while the control group refers to the individuals that do not receive the treatment in both time periods. The DID estimator consists of taking the difference in the average outcome in the treated group before and after the treatment minus the difference in the average outcome in the control group before and after the treatment. In order to avoid the violation of the parallel trend assumption between the treated and the control groups (that is, the outcome variable follows the same trend over time in the treated and the control group in the absence of the treatment), we also include a set of relevant covariates in the models.

Our results suggest that the impact of HSR in Spain is mixed, and differs according to the specific outcome variable in consideration. Although we find a positive effect of HSR on job creation, the effects on output per capita growth is at best very moderate. We also find evidence in favour of an asymmetric effect of HSR across space (provinces) through relocation of firms.

*Keywords:* Difference-in-Differences, High-Speed Rail, Spain

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