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An econometric evaluation of the management of large-scale transport infrastructure in Spain during the great recession: Lessons for infrastructure bubbles

José I. Castillo-Manzano [a,*], Diego J. Pedregal [b], Rafael Pozo-Barajas [a]

[a] Applied Economics & Management Research Group, University of Seville, Spain
[b] Escuela Técnica Superior de Ingenieros Industriales, Universidad Castilla-La Mancha, Spain

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ABSTRACT

This paper reviews the way that air, rail, and toll motorways infrastructure have evolved in Spain since the beginning of the century, when all these types of transport have been subjected to a far-reaching economic crisis. Investments made in infrastructure during this time will also be analyzed in relative terms and compared to other countries in the European Union, as will the various policies applied to each of these modes of transport. The methodology applied in this paper is of the bottom-up type, in the sense that a thorough univariate–uniequational analysis is performed before proceeding to more complex, multivariate models. We found that the policy to drop fare prices for the HSR (*AVE*) has had an almost 14% positive effect on the number of passengers per kilometer for HS and long-distance trains, but it has also had a negative effect of as much as 16.7% on the number of domestic air passengers. The increase in airport taxes has not affected any of the endogenous variables, or major public investments in air terminals and new HSR lines, except for the Madrid–Barcelona *AVE* and Barcelona's T1. Domestic air transport has been seen to be more sensitive to the economic cycle than the other modes of transport. This paper contains a set of results that justify the need to use full and accurate "economic modeling" in the planning and management of what is generally very costly transport infrastructure.

1. Introduction

The specialized literature has traditionally shown that GDP and transport infrastructure form a virtuous circle according to which any increase in a country's GDP raises demand for transport services (Annema and De Jong, 2011; Dargay et al., 2007), which in turn leads to an increase in investment in transport infrastructure. For Kim (2002), a 1% increase in GDP results in a similar 0.99% increase in money allocated to transport infrastructure. This increase then leads to greater GDP growth both in countries that are developed (Köhler et al., 2008) and those that are not (Ding, 2013). GDP and transport can be seen to be very closely bi-directionally related, although this relationship weakens when economic development grinds to a halt (Beyzatlar et al., 2014).

From the beginnings of industrialization, investment in transport has been one of the main conditions for countries' embarking on economic development (Rostow, 1960). The belief that investment in transport generates economic growth has often been used as justification for allocating resources to the sector. However, this general relationship is being questioned today (see, for example, Banister and Berechman, 2003) and depends on the type of infrastructure being promoted (see, for example, Bonatti and Campiglio, 2013). Whether this is the case or not, there are many examples of countries that are currently banking on investment in infrastructure, and primarily in transport, to drive their economic development forward. Some transport infrastructure-based plans can currently be found all round the world, especially in Asia. This is the case in Thailand, for instance, with a €50,000 m investment according to the Royal Thai Embassy (2015), as well as in China, Japan and India, with €65,000 m, €35,000 m and €25,000 m investments, respectively, to name but a few examples.

However, if there is a single country that epitomizes this policy during the recent period of growth seen during the first decade of the 21st century, it is Spain. During this period the country generated what has been considered a giant transport infrastructure bubble and become a paradigmatic case of oversupply and of mismatch with demand (Albalate et al., 2015), with a 15 year plan (2005–2020) called the PEIT that envisaged a €249,000 m investment in transport infrastructure (Ministry of Development, 2005). Changes in the economic situation forced the investment to be downscaled (see Fig. 1), meaning that the PEIT had to be replaced with the PITVI, a new 12 year plan (2012–2024) that estimates an investment of €138,000 m in transport

* Corresponding author at: Facultad de Ciencias Económicas y Empresariales, University of Seville, Avda. Ramón y Cajal, 1, 41018 Seville, Spain. Tel.: +34 954 556727; fax: +34 954 557629.
E-mail addresses: jignacio@us.es (J.I. Castillo-Manzano), diego.pedregal@uclm.es (D.J. Pedregal), pozo@us.es (R. Pozo-Barajas).

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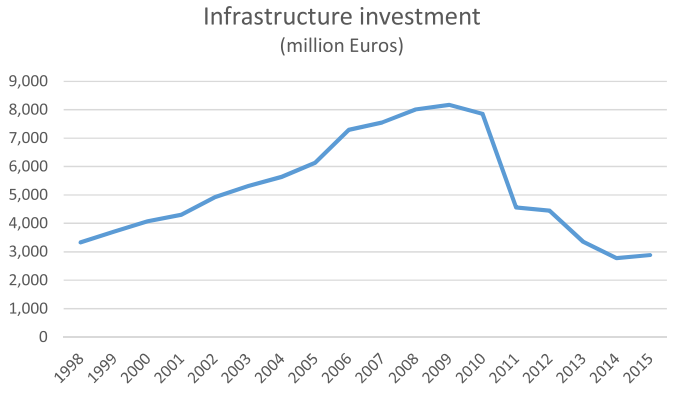

Fig. 1. Spanish State investment in infrastructure. Data on investments in infrastructure made by the Ministries of Development and the Environment.
Source: SPEG (1998-2015).

infrastructure (Ministry of Development, 2015). Parallel to this, the European Union has put forward the Junker Plan, which plans to devote €220,000 m to transport, energy and telecommunications infrastructure (European Commission, 2014), made possible by the ease with which inflation has been contained within the Eurozone (Dracos and Kouretas, 2015).

The present paper analyzes the way that Spanish economic infrastructure has evolved at the beginning of the century (focusing on airports, high speed rail (hereinafter, the *AVE*) and turnpikes or toll highways (hereinafter, *toll motorways*)). To justify the economic relevance of this case study, the evolution of Spanish transport infrastructure is analyzed in relative terms and compared to other countries in the European Union. The Spanish HSR has become the largest HSR network in the EU and the OECD (Albalate and Bel, 2011) and the same is true of the Spanish motorway network, which is also the largest in the EU (Eurostat, 2015). Similarly, the Spanish airport financing and management model and the high number of airports per capita are unparalleled among medium-sized and large continental countries in Europe and the OECD (Bel and Fageda, 2011).

Subsequently, a study is conducted of the traffic sensitivity of the various types of infrastructure under analysis in the face of the extreme conditions presented by an adverse economic cycle.

After this spectacular investment process, actions and strategies began to be implemented to optimize the effects (de Ureña, 2012) of this infrastructure and adapt it to an adverse economic cycle. In fact, the main objective of the present study is to evaluate the effects of the main measures taken in this respect during the current economic crisis. Especially noteworthy are the steep increases in airport fees and the reduction in AVE fares. In fact, the public sector can be seen to have used totally antagonistic strategies: while the strategy for air transport has clearly been to maximize short term profits by raising airport charges in tandem with more sophisticated strategies to capture non aeronautical revenue (a good example of this is the latest pricing policy for long term car parks) and the downsizing of the workforce, attempts have been made to incentivize demand for high speed rail by reducing fare prices significantly. Meanwhile, slight increases have been seen in toll motorway fees that have generally been in keeping with the low inflation rate during the period.

Lastly, the possible effects of some of the most emblematic infrastructure works are analyzed as control variables, specifically the AVE line from Madrid to Barcelona and the new and extremely costly extensions to Madrid and Barcelona-El Prat airports (approx. €6200 m and over €3000 m, respectively).

This article is organized as follows: Section 2 describes the way that large transport infrastructure has evolved in Spain. Section 3 explains the variables and the methodology used. Section 4 sets out and discusses the empirical findings. Finally, Section 5 presents the study conclusions.

2. The case of Spain

During the years of great economic growth in Spain, at the time of the real estate boom, large investments were made in transport infrastructure: from 471 km. of track at the beginning of 2003, Spanish HSR jumped to being the second longest with 2383 km. in 2014 (Fig. 2). There are currently another 2135 km. under construction or in the planning stage, and only China's HSR system is greater in length (Albalate and Bel, 2011). Fig. 3 compares HSR kms per thousand billion € of GDP and per million inhabitants in Spain, with the Eurozone and the European Union. At the same time, airports were built in nearly all the provinces, including seven new airports since 2007 that raised the overall number from 41 to 48. As far as road transport is concerned, new motorways were built. Some of these were public, while others were the result of public–private collaborations, with the case of the Madrid radials standing out. Toll motorways increased from 1739 km in 2001 to 2529 km in 2008.

This growth put the Spanish AVE in the international spotlight. However, its planning was criticized for there having been no prior analysis (Albalate and Bel, 2012) despite the fact that detailed planning had been regarded as a necessity since the 1960s, given the complexity of decision making in transport infrastructure (Levinson et al., 2012) and its high cost (De Rus and Nombela, 2007). Yet this investment trend, with not even the briefest of cost-benefit analyses being done beforehand, was not only the case in Spain. By way of example, most of the 30 Trans-European Transport Network's priority projects analyzed by Proost et al. (2014) were also at fault. Another similar example can be found in Asia, where Utsunomiya and Hodota (2011) also concluded that it is difficult to justify the investments made from the economic point of view.

On the political level, the justification of such large investment in the AVE was underpinned by the disproportionate stress put on the supposed positive effect of infrastructure on regional economic growth (see Hong et al., 2011, for example, on this relationship). In fact, political discourse justified the AVE with the tens of thousands of new jobs that would be generated by the increased numbers of travelers (see Martin and Nombela, 2007). Another objective was to reduce the environmental and social costs of air and road transport (congestion, pollution, noise and traffic accidents) (see Román and Martín, 2011 regarding this case, and Kremers et al., 2002, as a general example of the importance of including environmental costs in transport planning).

As can be seen in Fig. 4, there are 48 airports in Spain included one autonomous airport in the province of Lleida. Of these, the first four in terms of numbers of passengers took almost 60% of the 187 million passengers in 2013, while the last 22 barely reached 1% all together. According to Lozano and Gutiérrez (2011) this last group of airports struggle to reach any level of efficiency, with seven accruing a debt of €15,000 per passenger in 2013, while in the case of Huesca–Pyrenees airport this rose to €232,000.

Unfortunately, data are only available for 2010 to compare the situation of the Spanish airport system with nearby countries'. However, in 2010 Spain had 1.01 airports per million inhabitants and 43.48 airports per every thousand billion € of GDP. The mean values for these indicators in the Eurozone countries were 0.69 and 24.04 respectively, while they stood at 0.61 and 24.00, respectively, for EU28 countries. The differences are even greater when compared with the three largest European economies by size and population: the values for France were only 0.56 and 18.01; those for Italy were even lower, 0.39 and 14.32, and there is practically no comparison with the figures for Germany, 0.23 and 7.33 (ACI-Europe, 2010).

Most of the investment in toll motorways was made between 2001 and 2007 (see Fig. 5). Several of the State motorways as well as the radial motorways around Madrid were built in collaboration with the private sector, that is, in public–private partnerships, as is the case in other countries (Leruth, 2012).

The expectation was that, as a whole, this air, rail and road infrastructure would lead to increased competition (see, for example,